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I 19.8:1928 pt.2

U. S. DEPARTMENT OF COMMERCE
R. P. LAMONT, Secretary
BUREAU OF MINES
SCOTT TURNER, Director

MINERAL RESOURCES
OF THE
UNITED STATES
1928

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PART II—NONMETALS

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GOVERNMENT PRINTING OFFICE
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SUMMARY OF CONTENTS

Page

- Abrasive materials 237–252
  - Artificial abrasives 251
  - Introduction 237
  - Natural abrasives 238
    - Abrasive diamonds 249
    - Corundum and emery 242
    - Diatomite 245
    - Garnet 242
    - Grindstones and pulpstones 239
    - Imports and exports 250
    - Millstones 238
    - Miscellaneous abrasive materials 250
    - Oilstones and other whetstones, scythestones, rubbing stones, etc 241
    - Pebbles for grinding and flint lining for tube mills 248
    - Pumice and pumicite 247
    - Tripoli 243
- Asbestos 97–111
  - Chief sources 98
  - Grades 98
  - Imports and exports 103
  - Literature 111
  - Market conditions 99
  - Notes on production in foreign countries 105
    - Africa 107
    - Australia 109
    - Canada 105
    - Cyprus 109
    - Madagascar 110
    - Russia 110
  - Outstanding events 103
  - Prices 101
  - Production 99
  - Properties of asbestos 97
  - Review by States 100
  - Uses 97
  - Varieties 97
  - World production 105
- Asphalt and related bitumens 391–422
  - Acknowledgments 422
  - Imports and exports 418
    - Exports 419
    - Imports 418
  - Manufactured or petroleum asphalt 398
    - Asphalt associations 418
    - Distribution by rail 410
    - Distribution by water 411
    - Domestic demand 412
      - North Central district 416
      - Northeastern district 413
      - Pacific-Rocky Mountain district 416
      - Southeastern district 414
      - Southwestern district 415
    - General statement 398
    - Geographic location of manufacture 402
      - California district 404
      - East coast district 403
      - Gulf coast district 403
      - Indiana-Illinois district 404
    - Producers 417
    - Refinery production 399
    - Refinery stocks 404
    - Sales by uses 406
      - Miscellaneous uses 409
      - Paving 406
      - Roofing and waterproofing 409
    - Seasonal variation in manufacture 402
    - Source of raw material 400
  - Native asphalts and bitumens 392
    - Bituminous rock 392
      - Distribution 395
      - Exports 395
      - Sales 392

Page

- Asphalt and related bitumens—Continued.
  - Native asphalts and bitumens—Contd.
    - Gilsonite 396
    - Ichthyol 397
    - Ozokerite 397
    - Producers 398
    - Wurtzilite (elaterite) 397
  - Summary tables 391
  - World production 422
- Barite and barium products 227–235
  - Barium products 230
    - Barium chemicals 232
    - Growth of use of barium pigments 231
    - Imports and exports 233
    - Lithopone 231
    - Refined ground barite 230
  - Crude barite 227
    - Consumption by uses 228
    - Imports 229
    - Sales 227
    - Stocks at mines 228
    - World production 229
  - Prices 234
  - Producers 235
- Briquets. *See* Fuel briquets.
- Bromine. *See* Salt, bromine, and calcium chloride.
- Calcium chloride. *See* Salt, bromine, and calcium chloride.
- Carbon black 31–35
  - Exports 35
  - Producers 34
  - Production by States and districts 33
  - Summary 31
- Cement 337–372
  - Cement production in Canada 371
  - Chief hydraulic cements 339
  - General review 337
  - Hydraulic cement plants 339
  - Imports and exports 367
    - Exports 369
    - Imports 367
  - Masonry, natural, and puzzolan cements 365
  - Portland cement 345
    - Bulk shipping 357
    - Domestic consumption 352
    - Local supplies 356
    - Manufacturing conditions 359
      - Capacity 362
      - Fuels 360
      - Plants 359
    - Prices 357
      - At factories 357
      - At markets 358
    - Production, shipments, and stocks 345
    - Special cements 364
- Clay 187–196
  - General conditions 187
  - Imports and exports 196
  - Production 189
  - Production by uses 194
- Coal 423–606
  - Acknowledgments 423
  - Consumption, stocks, and distribution 508
    - Consumption 508
    - Distribution 512
      - Bituminous coal loaded for shipment by individual railroads and waterways, as reported by operators 514
      - Lake shipments of anthracite 522
      - Lake shipments of bituminous coal 519

Page
- Coal—Continued.
  - Consumption, stocks, and distribution—Continued.
    - Distribution—Continued.
      - Mine fuel, local sales, coal coked at mines, and shipments 512
      - New England movement 525
      - Receipts at head of Lake Superior 523
      - Tidewater bituminous coal shipments 523
    - Fuel economy 508
    - Stocks of coal held by consumers 510
  - Detailed statistics of bituminous coal, by States and counties 542
    - Coal produced and consumed in Alaska 557
    - Tables of production, value, men employed, days worked, and output per man in 1928 542
  - Detailed statistics of hard-coal industry outside of Pennsylvania 557
    - Average value per net ton 560
    - Distribution of western hard coal 566
    - Four separate producing areas 563
    - Hard-coal industry in Western States 565
    - Hard-coal industry of Virginia 563
    - Men employed, time worked, and output per man per day 567
    - Need of separate figures 557
    - Total annual production 559
  - Detailed statistics of Pennsylvania anthracite 571
    - Anthracite's effort to meet competition 577
      - Cooperation with dealers in sales effort 578
    - Anthracite situation 572
      - Decline in prices of domestic coal 574
      - Losses in shipments and increased use of fuels in place of anthracite 573
    - Details of shipments, by regions and sizes 591
    - Dredge operations 605
    - Fresh-mined and culm-bank coal, breaker and washery product 589
      - Anthracite shipped from breakers, washeries, and dredges since 1890 590
      - Culm-bank coal 590
      - Reconciliation of fresh-mined, culm-bank, and breaker product 589
    - Labor statistics 602
    - Local sales 596
    - Methods of mining 604
    - Movement toward mechanized heating 575
      - Automatic heat and anthracite 576
      - Househeating with manufactured gas 575
      - Oil as a domestic fuel 575
    - Number of operations 602
    - Production, by fields and counties 584
    - Production, by weeks and months 580
    - Production in the Lehigh, Schuylkill, and Wyoming regions 581
    - Statistical summary 571
    - Trends in sizes shipped 594
    - Trends in values and prices 598
      - Average sales realizations, 1921–1928 598
        - Average value for all sizes 599
        - Further declines on domestic sizes 598
        - Increase in prices of steam sizes in 1928 599
        - Prices of pea coal 599
      - Average values of shipments, local sales, and colliery fuel 601
      - Sources of information and methods of analyses 598
        - Estimates included in the figures of value 598
        - Margins of sales agents not included 598
  - Growth of the industry 446
    - Historical summary 446
    - Relative rate of growth of coal and other sources of power 447

Page
- Coal—Continued.
  - Imports and exports 527
    - Exports 530
      - General features 530
      - Sea-borne export trade 531
      - Trade with Canada and Mexico 530
    - Imports 527
    - Shipments to Alaska, Hawaii, and Porto Rico 538
  - Labor statistics 472
    - Days worked by mines 474
    - Length of working day 475
      - Average time spent underground 477
      - Established working day 475
    - Men employed 472
    - Output per man 478
    - Strikes, suspensions, and lockouts 479
  - Methods of collecting the statistics 442
    - Anthracite, bituminous coal, and lignite 445
      - Hard coal mined outside of Pennsylvania 445
      - Lignite 445
      - Pennsylvania anthracite industry 445
      - Two industries 445
    - Completeness of the returns 442
      - Commercial mines and wagon mines 442
      - Data on labor in wagon mines 444
      - Method of obtaining data on commercial mines 443
      - Method of obtaining data on wagon mines 443
      - Omission of country coal banks 444
    - Units of measurement 444
    - Voluntary cooperation 442
  - Methods of mining and preparation 481
    - Cleaning by wet and dry methods 506
    - Loading machines and conveyors 498
      - Distribution of conveyors and pit-car loaders 501
      - Distribution of machine-loaded tonnage in 1928 501
      - Increase by types of machines, 1926–1928 499
      - Increase in machine loading, by States 500
      - Increase in machine loading proper, 1923–1928 500
      - Number of machines in use 503
      - Rank of States in per cent of output mechanized 503
      - Summary 498
      - Total production with all types of machines, by States 502
    - Methods of cutting and shooting 491
    - Review of engineering progress in bituminous industry, 1913–1928 481
      - Developments in mining practice 481
        - Electrification of haulage 481
        - Electrification of mine power 481
        - Machine cutting 482
        - Mechanical loading 482
        - Power drilling of shot holes 482
        - Problems raised by mechanical loading 484
        - Tonnage loaded by machine 483
        - Types of loading machinery 483
        - What mines can be mechanized? 486
      - Developments in preparation 487
        - Screen sizing 487
        - Washing and pneumatic cleaning 488
      - Increase in output per man per day 488
      - Need of further effort 490
      - Progress in utilization of fuel 488
        - Fuel economy 489
        - Storage practice 489
    - Screening and sizing 506
    - Stripping operations 494
    - Undercutting machines 492
  - Number and size of mines 464
  - Production 452
    - Monthly production of bituminous coal, less coal equivalent of coke made 463

Coal—Continued. Page
- Production—Continued.
  - Production, by fields 455
  - Production, by geologic provinces 457
  - Production, by weeks and months 458
  - Production summaries, by States 452
  - Total production since beginning of mining 454
- Review of coal industry in 1928 424
  - Bituminous coal 424
    - Decrease in number of mines and miners in 1928 431
    - Further decline of export trade 425
    - Importance of long-time economic forces 427
    - Increased productivity per worker 432
    - New record in lake cargo movement 431
    - Prices and values in 1928—lowest of decade 429
    - Progress made in engineering 432
    - Slight decline in industrial consumption 425
    - Steadier working time in 1928 432
    - Withdrawals from storage to supply current needs 427
  - Pennsylvania anthracite 432
- Statistical summary 436
- Value and prices 467
  - Average export prices 471
  - Average value per ton 469
  - Definition of values reported 467
  - Estimates of value included in statistics 468
  - Spot prices 471
- World production of coal 538

Coke and by-products 705–801
- Acknowledgments 709
- By-product coke ovens owned by city gas companies, included by Bureau of the Census in manufactured-gas industry 796
- Coke and coke breeze 717
  - Capacity of by-product ovens 730
  - Coke breeze 743
  - Coke in Canada 774
  - Consumption of coke 763
  - Domestic coke 753
  - Exports and imports 771
  - Furnace, foundry, and other coke 745
    - Beehive coke distributed in 1928 747
    - By-product coke distributed in 1928 745
    - Relative growth of furnace, foundry, and domestic coke 749
    - Source of information 745
  - Growth of industry 717
  - Monthly and weekly production 718
  - Number and type of ovens 726
  - Preparation and source of coal charged 736
    - Source of by-product coal in 1928 737
    - Washed and unwashed coal 736
  - Production by furnace and nonfurnace plants 721
  - Production by States and districts 723
  - Quantity and cost of coal charged 731
  - Retail dealer as a distributor of coke 758
  - Shipments by rail and water 768
  - Stocks of coke 761
  - Value and price 765
  - World production 775
  - Yield of coke per ton of coal 743
- Coke-oven by-products 775
  - Ammonia 783
  - Coke-oven gas 788
  - Light oil and its derivatives 785
  - Naphthalene 794
  - Summary tables 775
  - Tar 781
- Production of coke, 1880–1928, by States 799
- Review of industry in 1928 705
- Scope of report 713
  - Accounting practices of coke operators that affect statistics 713
  - Definitions of terms used in statistical tables 713

Coke and by-products—Continued. Page
- Scope of report—Continued.
  - Six coke-producing industries 713
    - Beehive and by-product oven coke 713
      - By-product ovens operated by city gas companies included 714
      - Scope of this report—beehive and by-product coke 713
    - Coal-tar coke 716
    - Gas-house coke 714
    - Low-temperature coke 715
    - Petroleum coke 716
- Statistical summary 709

Corundum. *See* Abrasive materials.

Cryolite. *See* Fluorspar and cryolite.

Diatomite. *See* Abrasive materials.

Emery. *See* Abrasive materials.

Feldspar 67–80
- General conditions 67
- Imports 79
- Improved technical control 69
- Industry by States 75
  - Arizona 76
  - California 76
  - Colorado 76
  - Connecticut 76
  - General data 75
  - Illinois 76
  - Maine 76
  - Maryland 77
  - New Hampshire 77
  - New Jersey 77
  - New York 77
  - North Carolina 77
  - Ohio 78
  - Pennsylvania 78
  - South Dakota 78
  - Tennessee 79
  - Virginia 79
- Lack of uniformity 69
- Milling methods 72
- Mining methods 71
- Occurrence 68
- Production 73
  - Crude feldspar 73
  - Ground feldspar 74
- Specifications 71
- Uses 70
- Varieties of feldspar 68
- World production 79
  - Canada 80

Fluorspar and cryolite 13–30
- Cryolite 30
- Fluorspar 13
  - Consumers 29
  - Consumption—stocks at consumers' plants 28
  - History of production 16
  - Imports and exports 25
  - Industry in 1928, by States 18
    - Colorado 18
    - Illinois 19
    - Kentucky 20
    - Nevada 23
    - New Mexico 24
  - Production and shipments 13
  - Shipments, by uses 18
  - Stocks at mines or shipping points 25
  - Uses 27
    - Ceramic industries 28
    - Chemical industries 28
    - Metallurgical industries 27
    - Optical fluorspar 28
  - World production 29

Fuel briquets 1–11
- Binders 9
- Capacity of plants 7
- Distribution 4
- Foreign trade in briquets 10
- Hours operated per day 8
- Number of plants in operation 5
- Principal expenses and value added by manufacture 4
- Producers' stocks of finished briquets 2
- Production 1
- Raw fuels 8
  - Kinds 8
  - Sources 8

Fuel briquets—Continued — Page
  - Value — 3
  - World production — 10
- Fuller's earth — 37-40
  - General conditions — 37
  - History — 38
  - Imports and exports — 39
  - Occurrence — 37
  - Production — 38
  - Uses — 37
- Garnet. *See* Abrasive materials.
- Gas, natural. *See* Natural gas.
- Gasoline from natural gas. *See* Natural gasoline.
- Graphite — 81-88
  - Imports and exports — 84
  - Introduction — 81
  - Manufactured graphite — 83
  - Prices — 83
  - Production — 81
  - Uses — 82
  - World graphite situation during 1928 — 86
  - World production — 86
- Grindstones. *See* Abrasive materials.
- Gypsum — 155-174
  - Imports and exports — 160
    - Exports — 162
    - Imports — 160
  - Introduction — 155
  - Kettles and kilns in operation — 159
  - Prices and markets — 159
  - Production — 156
  - Review of gypsum industry — 163
    - Gypsum enterprises — 163
      - Importers of crude gypsum — 165
      - Manufacturers of gypsum products — 163
      - Miners only — 164
    - New companies and consolidations, etc — 165
    - New plants and plant increases — 166
    - New products — 167
    - Technical developments — 168
  - Synthetic gypsum — 169
  - World production — 170
    - Canada — 171
      - Exports and imports — 173
      - Notes on Canadian plants — 174
      - Production — 171
- Lime — 175-186
  - Exports and imports — 184
  - Production — 176
    - Agricultural lime and other liming materials — 181
    - Building lime — 180
    - Chemical lime — 181
    - Hydrated lime — 182
  - Shipments — 185
  - Summary — 175
- Magnesium and its compounds — 127-153
  - Dolomite — 143
    - Basic magnesium carbonate — 144
    - Carbon dioxide — 145
    - Dead-burned dolomite — 144
    - Dolomite products — 143
    - High-magnesium lime for sulphite paper mills — 145
  - Introduction — 127
  - Magnesite — 128
    - Annual supply — 135
    - Domestic industry — 135
      - California — 135
      - Nevada — 135
      - Washington — 136
    - Domestic production — 128
      - Caustic calcined magnesite — 129
      - Crude magnesite — 129
      - Dead-burned magnesite — 131
    - Exports — 134
    - Imports — 133
    - Foreign industry — 136
      - Australia — 136
      - Austria — 137
      - British India — 138
      - Canada — 139
      - Greece — 140
      - Manchuria — 142
      - Russia — 142
      - Venezuela — 142
      - Yugoslavia — 143

Magnesium and its compounds—Continued. — Page
  - Magnesite—Continued.
    - Market and prices — 131
    - World production — 136
  - Magnesium — 145
    - Development and outlook — 147
    - Imports — 147
    - Production — 145
  - Magnesium salts — 150
- Marl, calcareous — 182
- Mica — 607-614
  - Consumption of mica splittings — 611
  - Imports and exports — 612
  - Prices — 611
  - Production — 607
    - Review by States — 608
  - Scrap and ground mica — 610
  - World production — 614
- Millstones. *See* Abrasive materials.
- Natural gas — 373-389
  - Interstate transportation — 385
  - Natural-gas wells — 387
  - Production and consumption — 374
    - Domestic consumption — 379
    - Industrial consumption — 381
  - Summary — 373
- Natural gasoline — 205-219
  - Monthly statistics of natural gasoline — 215
  - Natural gasoline turned into pipe lines — 213
  - Natural gas treated — 214
  - Production — 208
  - Spot prices of natural gasoline — 218
  - Stocks of natural gasoline at plants — 212
  - Summary — 205
- Oilstones. *See* Abrasive materials.
- Pebbles for grinding. *See* Abrasive materials.
- Petroleum — 615-703
  - Consumption — 672
  - Gravity of crude petroleum — 697
  - Imports and exports — 663
  - Oil shale and shale oil — 703
  - Prices and values — 676
  - Production — 622
    - Domestic production — 622
      - By fields or districts — 622
      - By months — 622
      - By States — 624
        - Arkansas — 632
        - California — 633
        - Colorado — 638
        - Kansas — 639
        - Louisiana — 640
        - Montana — 642
        - New Mexico — 643
        - Oklahoma — 644
        - Texas — 645
        - Wyoming — 653
        - Other States — 654
    - World production — 657
      - Production of petroleum in foreign countries in 1928, by fields — 662
  - Production of petroleum and royalties from wells under Federal control — 699
  - Shipments from California through the Panama Canal — 666
  - Stocks — 666
  - Summary — 615
  - Summary of refinery statistics — 700
  - Wells — 688
- Phosphate rock — 253-275
  - Consumption of phosphate rock in the United States — 269
  - Domestic mine production — 253
  - Exports — 264
    - Phosphate rock — 264
    - Superphosphates and other fertilizer materials — 267
  - General conditions — 253
  - Imports — 268
  - List of consumers of phosphate rock, by uses — 270
  - Review by States — 258
    - Florida — 258
    - Tennessee — 261
    - Western States — 262
    - Other States — 263
  - Sales of domestic phosphate rock — 254
    - Sales, by uses — 254
      - Blast-furnace use — 257
      - Building-construction trade — 257

Page

- Phosphate rock—Continued.
  - Sales of domestic phosphate rock—Con.
    - Sales, by uses—Continued.
      - Direct application to the soil 256
      - Fertilizer filler 257
      - Phosphorus and chemicals containing phosphorus 255
      - Stock and poultry feed 257
      - Superphosphates 255
  - Stocks 257
  - World production 274
- Potash 89–96
  - Consumption 94
  - Imports and exports 90
  - Market conditions 94
  - Prices 94
  - Producing localities 90
  - Production and sales 89
  - Summary of world production 95
- Pulpstones. *See* Abrasive materials.
- Pumice. *See* Abrasive materials.
- Pyrites. *See* Sulphur and pyrites.
- Quartz. *See* Silica.
- Salt, bromine, and calcium chloride 113–126
  - Bromine 124
  - Calcium chloride 125
  - Salt 113
    - Imports and exports 115
    - Localities producing salt in the United States in 1928 119
    - Production 113
    - World production 118
- Sand and gravel 277–292
  - Exports 292
  - Geographic distribution of sand and gravel production 287
  - Glass sand 290
  - Imports 291
  - Molding sand 290
  - Production 277
  - Values 287
- Scythestones. *See* Abrasive materials.
- Silica 221–225
  - Imports 224
  - Introduction 221
  - Production 221
    - Ground sand and sandstone 223
    - Quartz 222
- Slate 41–53
  - Causes of lack of growth 44
  - Conditions in the industry 41
  - Definition of slate 42
  - Determination of properties of slate 43
  - Imports and exports 46
  - Origin and occurrence 42
  - Physical properties 42
  - Production 44
  - Review by districts 48
  - Shipments 52

Page

- Slate—Continued.
  - Slate costs 44
  - Structural features of slate 42
  - Technology 43
  - Uses 43
- Soapstone. *See* Talc and soapstone.
- Stone 293–335
  - Exports and imports 298
  - Production by kinds and States 301
    - Basalt and related rocks (trap rock) 306
    - Crushed stone (concrete and road metal and railroad ballast) 330
    - Granite 301
    - Limestone 314
      - Building stone 319
    - Marble 308
      - Producing localities—marble, "onyx," and serpentine 309
      - Serpentine 309
    - Miscellaneous stone 327
    - Sandstone 323
      - Bluestone 327
  - Production by States 297
  - Summary of production 293
- Sulphur and pyrites 55–65
  - Introduction 55
  - Pyrites 63
    - Domestic production 63
    - Imports and exports 64
    - World production 64
  - Sulphur 56
    - Consumption 61
    - Domestic production 56
    - Foreign production 62
    - Imports and exports 58
- Talc and soapstone 197–204
  - Composition and properties 198
  - Imports and exports 203
  - List of producers 202
  - Prices 202
  - Production 197
  - Review by States 200
    - California 200
    - Georgia 200
    - Maryland 200
    - New York 200
    - North Carolina 201
    - Pennsylvania 201
    - Vermont 201
    - Virginia 201
  - Uses 198
    - Dependence of use on physical properties 198
    - Uses enumerated 199
  - World production 203
    - Talc and soapstone in Canada 204
- Tripoli. *See* Abrasive materials.
- Tube-mill lining. *See* Abrasive materials.

ILLUSTRATIONS

Figure | Page

1. Distribution of fuel briquets in 1928 ... 5
2. Quantity and value of natural gasoline produced and volume of natural gas treated at plants, 1911–1928 ... 206
3. Production and consumption of natural gasoline, 1924–1928 ... 207
4. Growth of natural-gas consumption in the United States, 1906–1928 ... 379
5. Quantity and value of natural gas consumed in the United States, 1906–1928 ... 381
6. Interstate movement of natural gas in the United States in 1928 and relative importance of principal States in production and consumption ... 385
7. Average production of bituminous coal per working day in each month, 1905–1928 ... 426
8. Total commercial stocks of bituminous coal, November 11, 1918, to October 1, 1929 ... 428
9. Monthly average spot prices of bituminous coal f. o. b. mines, as quoted by Coal Age, 1906–1928 ... 430
10. Monthly prices of Pennsylvania anthracite f. o. b. mines, as quoted by Coal Age, 1913–1928 ... 434
11. Production of bituminous coal, Pennsylvania anthracite, and all coal, 1890–1928 ... 435
12. Relative rate of growth of annual supply of coal, oil and gas, and water power in the United States, 1870–1928 ... 448
13. Per cent of the energy supply of the United States derived from coal, oil and gas, and water power, 1889–1928 ... 450
14. Trend of bituminous coal production and of mine capacity in the United States, 1899–1928 ... 451
15. Number of commercial bituminous coal mines in each size class, 1905–1928 ... 467
16. Per cent of total output of bituminous coal mined by different methods, 1911–1928 ... 492
17. Tonnage of bituminous coal loaded by machines (mobile loading machines, scrapers, and duckbills) in 1928 ... 501
18. Tonnage of bituminous coal handled by conveyors (shakers equipped with duckbills, hand-loading conveyors, and pit-car loaders) in 1928 ... 502
19. Bituminous coal cleaned at the mines by wet washing methods, 1906–1928 ... 507
20. Total tonnage of bituminous coal cleaned by wet washing and by dry mechanical methods, 1907, 1917, and 1928 ... 507
21. Shift in disposition of total output of bituminous coal, 1890–1928 ... 513
22. Exports of bituminous coal to Canada and Mexico and overseas, 1919–1928 ... 531
23. World consumption of coal, oil and gas, and water power, 1913, 1920, 1923, and 1928 ... 538
24. World production of coal and lignite, 1888–1928 ... 539
25. Relative rates of growth of bituminous coal, Pennsylvania anthracite, and other hard coals in the United States, 1913–1928 ... 560
26. Trends in the average value per net ton f. o. b. mines of bituminous coal, Pennsylvania anthracite, and other hard coal mined outside of Pennsylvania, 1913–1928 ... 561
27. Average values of hard coal mined in districts outside of Pennsylvania, 1913–1928 ... 565
28. Distribution of "Arkansas anthracite" for the coal year April 1, 1928, to March 31, 1929 ... 566
29. Daily average production of crude petroleum in the United States, total number of oil wells completed, and average price of a selected grade of Oklahoma crude, 1924–1928, by months ... 616
30. Daily average production of crude petroleum in flush fields, 1924–1928, by months ... 617
31. Supply and demand of all oils, 1918–1928 ... 619
32. Production of crude petroleum, 1927 and 1928, by States ... 624
33. World production of crude petroleum, 1904–1928, by countries ... 658
34. Stocks of crude petroleum, 1924–1928, by months ... 667
35. Daily average production, imports, runs to stills, and exports of crude petroleum, 1927 and 1928, by months ... 673
36. Posted prices of selected grades of crude petroleum, 1924–1928 ... 676
37. Wells drilled, 1924–1928, by months ... 688
38. Average daily production of beehive and by-product coke and of pig iron, by months, 1924–1929 ... 706
39. Stocks of unsold coke on hand at a group of 21 by-product plants making coke suitable for domestic use and supplying gas for city distribution, 1922–1928 ... 706
40. Average monthly prices of spot or prompt Connellsville coke at ovens, 1913–1928, as quoted by Iron Age ... 707
41. Production of petroleum coke, gas-house coke, and beehive and by-product coke in the United States, 1900–1928 ... 708
42. Average value of by-product coke and gross value of by-products and cost of coal per ton of coke produced ... 735
43. Sources of coal charged in by-product coke ovens in 1928, by field where mined ... 740
44. Location and capacity of furnace by-product coke plants ... 741
45. Location and capacity of nonfurnace or merchant by-product coke plants ... 742
46. By-product and beehive coke sold for furnace, foundry, other industrial, and domestic use ... 752
47. Fuels consumed for domestic heating and cooking in the United States, 1928 ... 753
48. Maximum distance that domestic by-product coke is shipped ... 754
49. Growth of sales of domestic by-product coke and gas-house coke, 1918–1928 ... 756
50. Price trends of domestic fuels, 1920–1928 ... 757
51. Per cent of the total deliveries made by retail coal dealers that consisted of coke, 1928 and 1929 ... 759
52. How retail dealers assist in carrying the seasonal storage of coke ... 759
53. Total stocks of by-product coke at producers' plants on the first of each month ... 764
54. The declining consumption of blast-furnace coke per gross ton of pig iron, 1913–1928 ... 764
55. The downward trend of coke prices ... 766
56. Average monthly price of by-product foundry coke in four markets, 1921–1928, as quoted by Iron Trade Review ... 768
57. Average yield of the principal by-products per net ton of coal carbonized in by-product coke ovens, 1915–1928 ... 777
58. Average receipts per unit for the principal refined light oils and other products at by-product coke plants, 1913–1928 ... 779
59. Gross value of the several by-products per ton of by-product coke produced, 1913–1928 ... 780
60. Spot prices of 90 per cent benzol, toluol, solvent naphtha, and flake naphthalene at New York, 1919–1928 ... 786
61. Average price of 90 per cent benzol in New York, producers' prices of pure benzol f. o. b. works, and tank-wagon price of gasoline, 1919–1928 ... 786
62. Per cent of total production of by-product oven gas that was wasted, burned in coking processes, or sold or used, 1915–1928 ... 789
63. Disposition of surplus coke-oven gas, 1922–1928 ... 789

MINERAL RESOURCES OF THE UNITED STATES, 1928—PART II

FUEL BRIQUETS

By O. E. Kiessling and J. M. Corse

PRODUCTION

The production of fuel briquets in 1928 was 947,423 net tons, valued at $7,705,617, according to reports courteously furnished to the Bureau of Mines by the operators of briquetting plants. In comparison with 1927, the production showed a decrease of 2.4 per cent but in comparison with 1925 an increase of 12.9 per cent.

Despite an abundant supply of anthracite and of bituminous coal throughout 1928 briquet sales declined only 4.8 per cent from the high level set during 1926, when demand was greatly stimulated by the anthracite strike. That a large proportion of the gain in production made during the strike period was retained in 1927 and 1928 is an indication of growth and stability in the briquetting industry.

Fuel briquets produced in the United States, 1927–28

	Production			Value		
	1927	1928	Increase or decrease	1927	1928	Increase or decrease
	Net tons	*Net tons*	*Per cent*			*Per cent*
Eastern States	196,726	228,767	+16.3	$1,293,918	$1,496,211	+15.6
Central States	630,066	605,725	−3.9	5,232,013	5,077,686	−2.9
Pacific Coast States	143,676	112,931	−21.4	1,459,234	1,131,720	−22.4
	970,468	947,423	−2.4	7,985,165	7,705,617	−3.5

The production of 228,767 tons in the Eastern States represented a gain of 16.3 per cent over 1927 and a decrease of 20.8 per cent from the record tonnage of 1926. Output in the Central and Pacific Coast States declined 3.9 per cent and 21.4 per cent, respectively, from 1927.

Wisconsin in 1928, as in other recent years, ranked first as a producer of briquets, and its three plants turned out more than half of the total output. The combined production in Wisconsin and Pennsylvania constituted more than 78 per cent of the total tonnage for the country.

The progress of the industry since 1907, the date of the first statistical survey covering fuel briquets, is recorded in the following table. During the past 10 years the use of briquets was stimulated by the anthracite shortages of 1920, 1922–23, and 1925–26. A large share of the gain thus made, however, was retained in 1927 and 1928, when abundant supplies of anthracite were available; this indicates the stable nature of the growth in demand. A feature of the development of the industry in the last decade has been the rapid increase in production in the Central States, where high transportation costs on anthracite stimulate the demand for other fuels suitable for domestic use. Between 1919 and 1928 the production of the Central States increased 313 per cent, while the output of all other States increased 129 per cent.

Fuel briquets produced in the United States, 1907–1928 [1]

Year	Net tons	Value	Year	Net tons	Value
1907	66, 524	$258, 426	1918	477, 235	$3, 212, 793
1908	90, 358	323, 057	1919	295, 734	2, 301, 054
1909	139, 661	452, 697	1920	567, 192	4, 623, 831
1910	(2)	(2)	1921	398, 949	3, 632, 301
1911	218, 443	808, 721	1922	619, 425	5, 444, 926
1912	220, 064	952, 261	1923	696, 810	5, 898, 698
1913	181, 859	1, 007, 327	1924	580, 470	4, 986, 622
1914	250, 635	1, 154, 678	1925	839, 370	7, 128, 404
1915	221, 537	1, 035, 716	1926	995, 332	8, 533, 179
1916	295, 155	1, 445, 662	1927	970, 468	7, 985, 165
1917	406, 856	2, 233, 888	1928	947, 423	7, 705, 617

[1] Figures for earlier years not available.

[2] No canvass for 1910.

The demand for briquets fluctuates with the seasonal character of househeating. Production, therefore, is curtailed and in many plants discontinued during the early spring and summer. As output must necessarily precede consumption by a period long enough to permit distribution to the consumer the period of greatest activity at the plants is in late autumn and early winter. In 1928 July marked the lowest ebb of output, while January, October, November, and December were the months of greatest production.

Monthly production of fuel briquets in the United States, 1924–1928, in net tons

Month	1924	1925	1926	1927	1928
January	80, 938	93, 310	125, 721	123, 239	119, 846
February	42, 609	62, 479	110, 815	79, 227	91, 162
March	24, 953	47, 504	66, 811	37, 557	56, 386
April	20, 183	26, 498	35, 281	28, 067	39, 547
May	17, 795	26, 350	31, 943	42, 243	91, 433
June	16, 017	28, 183	32, 870	52, 927	43, 514
July	25, 611	42, 224	40, 877	28, 692	30, 335
August	40, 743	63, 161	57, 603	72, 577	52, 658
September	65, 745	79, 118	80, 066	99, 261	69, 255
October	74, 873	118, 543	134, 543	131, 699	111, 736
November	80, 936	123, 316	140, 655	126, 149	119, 394
December	90, 067	128, 684	138, 147	148, 830	122, 157
	580, 470	839, 370	995, 332	970, 468	947, 423

PRODUCERS' STOCKS OF FINISHED BRIQUETS

In its questionnaire for 1928 the Bureau of Mines requested information on the quantity of finished briquets on hand in producers' yards on various dates in the year. The replies show that on January 1 producers had on hand 17,996 tons in comparison with 14,407 tons at the end of the year, indicating a net decrease of 3,589 tons in stocks during the year. This decrease was due to a steady downward trend in the stocks rather than to any abrupt change. Also it appears that the seasonal acceleration in demand during the fall and winter is met in the main by rapidly expanded production rather than by drawing upon accumulated producers' stocks.

Producers' stocks of finished briquets in 1928, in net tons

Jan. 1, 1928	17,996
July 1, 1928	16,366
Oct. 1, 1928	15,882
Jan. 1, 1929	14,407

VALUE

The total value of the briquets manufactured during 1928 was $7,705,617, a decrease of $279,548, or 3.5 per cent, when compared with 1927; the average value per net ton f. o. b. plant declined from $8.23 to $8.13. This drop in the average value per ton in 1928 is partly explained by the fact that the relatively low-priced product of Pennsylvania formed a much larger part of the total output than in 1927. For this reason the figure on average value per ton for the entire industry has doubtful significance because of varying conditions under which briquets are manufactured in different parts of the country. Among the factors that influence the value per ton at any plant the most important are probably the cost of raw materials and the prices of competing fuels. Consequently, the trend of prices from year to year is best indicated by the average value in particular localities, as shown by the following table:

Average value per net ton (f. o. b. plant) of briquets produced in Pennsylvania and in the Central States, 1911–1928

Year	Pennsylvania	Central States
1911	$2.37	$4.34
1912	2.68	4.47
1913	2.65	4.92
1914	2.48	4.83
1915	2.90	4.26
1916	3.83	4.73
1917	3.15	6.81
1918	4.11	8.17
1919	4.17	8.47
1920	$5.60	$9.23
1921	6.14	9.28
1922	5.93	9.02
1923	5.95	9.35
1924	5.82	9.00
1925	6.35	8.72
1926	6.74	8.86
1927	6.52	8.30
1928	6.38	8.38

In 1928, as in previous years, the value at the plant was lowest in the Eastern States where materials suitable for the manufacture of briquets are available at low cost and where competition with other fuels is especially keen. For the Eastern States the average value per ton f. o. b. plants was $6.54 and for the Pacific Coast States $10.02 in 1928. The average value f. o. b. producer's plant for the State of Pennsylvania was $6.38 a ton in 1928, compared with $6.52 in 1927 and $6.35 in 1925. The average value of the product of the Central States—most of which comes from the plants at the head of Lake Superior—was $8.38 in 1928, an increase of 8 cents over 1927 but a decrease of 48 cents from 1926.

These figures, however, do not indicate the prices paid by consumers. Some of the plants are long distances from the localities where their product is consumed, and to the value at the plant must be added the cost of transportation and the margin of the wholesaler or the retailer and sometimes both.

PRINCIPAL EXPENSES AND VALUE ADDED BY MANUFACTURE

By far the largest item of expense in the manufacture of briquets is the cost of raw materials. In 1927 the average cost of raw materials for 16 briquetting plants throughout the country, which produced 93 per cent of the total output, was $5.09 per ton, in comparison with expenditures of 17 cents per ton for salaries, 47 cents for wages, and 26 cents for power. The average value of the product was $7.86 per ton, and the difference between this figure and the total of principal expenses—$1.87—represents the value added by manufacture. This analysis is based on figures reported to the census of manufactures and includes all active plants canvassed by the Bureau of Mines in 1927 except the three making briquets from the carbon residue of oil gas.

Principal expenses, value of products, and value added by manufacture at 16 fuel briquetting plants in 1927, as reported to the census of manufactures

[This analysis covers all plants listed on p. 7, Fuel Briquets in 1927, except the three making briquets from the carbon residue of oil gas]

Item	Total	Per ton
Number of establishments	16	
Production (net tons)[1]	905, 601	
Principal expenses:		
Salaries	$149, 598	$0. 17
Wages	426, 584	. 47
Materials [2]	4, 609, 988	5. 09
Power and fuel used for power at plant	236, 411	. 26
Total	5, 422, 581	5. 99
Value of product	7, 116, 710	7. 86
Value added by manufacture	1, 694, 129	1. 87

[1] As reported by the same operators to the Bureau of Mines.

[2] Includes plant supplies in addition to raw materials for briquets.

About the same results as for 1927 were obtained from an analysis of the census of manufactures data for 1925. In that year the average per ton expenses of 12 briquetting plants producing 92 per cent of the total output were 16 cents for salaries, 47 cents for wages, and $5.10 for raw materials and power—a total of $5.73 per ton.

It should be carefully noted that only the most important, not all, of the items entering into cost are accounted for; hence the average of $1.87 per ton added by manufacture in 1927 gives an exaggerated impression of producers' margins. In addition to salaries, wages, raw materials, and power many other items of expense enter into the cost of producing a ton of briquets, including insurance, taxes, interest on investment in the plant, and charges for depreciation of equipment.

DISTRIBUTION

In its questionnaire for 1923 the Bureau of Mines requested information on the distribution of fuel briquets, and in that for 1928 it made a similar request. The replies for 1928 show that the output of 947,423 tons was widely distributed, being shipped into no less than 25 States. (Fig. 1.) The entire production of the plants in California and Maryland was consumed within the States of origin.

In comparison with the study for 1923 the distribution of briquets in 1928 shows that some changes have taken place during the past five years. (See Fuel Briquets in 1923, fig. 2, p. 44.) Among the most important are the loss of markets in the Central West by plants in Pennsylvania, the cessation of the movement from Virginia to New England, and the cessation of shipments into the Southern States of South Carolina and Georgia.

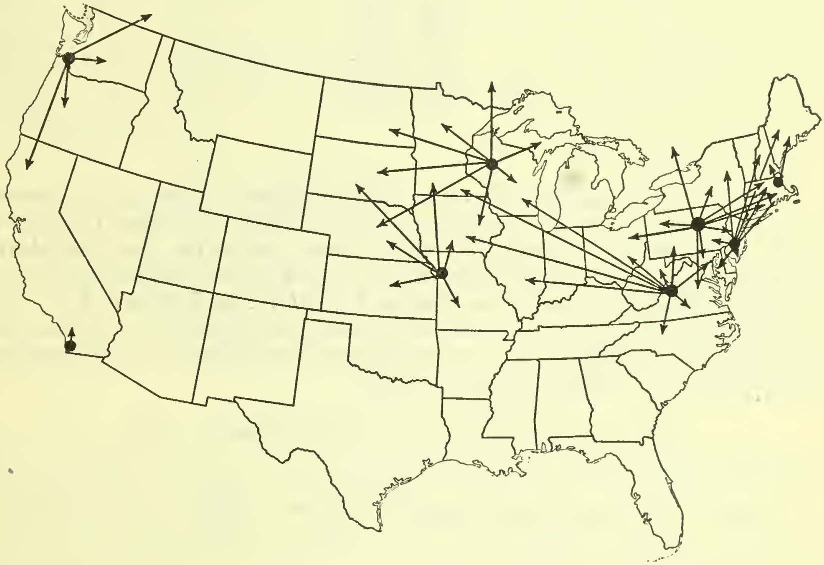

FIGURE 1.—Distribution of fuel briquets in 1928. For convenience in graphic presentation the three plants in Wisconsin are represented by a single dot, and likewise the four plants in Pennsylvania, the four plants in Virginia and West Virginia, the four plants in Washington and Oregon, and the three plants in New Jersey and Maryland.

NUMBER OF PLANTS IN OPERATION

Twenty-one plants reported production of briquets on a commercial scale in 1928, two more than in 1927 and 1926. The average production per plant in 1928 was 45,115 tons, more than four times the average of 10,402 tons in 1911, when there were also 21 active plants. In comparison with 1919, 1928 showed an increase of 75 per cent in the number of plants and 83 per cent in the average production per plant. The trend toward increased average output per plant has been one of the most interesting developments in the industry. Throughout its history in the United States briquet manufacture has been characterized by the erection of many small plants that have been dismantled or abandoned later and by the expansion of undertakings that have proved commercially successful.

Number and average production of briquet plants in operation in the United States, 1907–1928

Year	Plants in operation	Average production per plant (net tons)	Year	Plants in operation	Average production per plant (net tons)
1907	11	6,048	1918	12	39,770
1908	8	11,295	1919	12	24,645
1909	16	8,729	1920	15	37,813
1910	(1)	(1)	1921	15	26,597
1911	21	10,402	1922	14	44,245
1912	19	11,582	1923	14	49,772
1913	17	10,698	1924	12	48,373
1914	16	15,665	1925	17	49,375
1915	15	14,769	1926	19	52,386
1916	15	19,677	1927	19	51,077
1917	13	31,297	1928	21	45,115

[1] No canvass for 1910.

A list of the 21 plants active in 1928 follows. Two plants active in 1927 produced no briquets for sale in 1928, but three new ones began commercial operation during the year—the Northwestern Briquetting Co., at Ravensdale, Wash.; the United Coal & Dock Co., at Milwaukee, Wis.; and the Parlass Coal Co., at Deibler, Pa. In addition, operations were resumed by the Old Dominion Anthracite Corporation, Pulaski, Va., at the plant operated by the Empire Collieries Co. in 1926 but idle in 1927.

Briquetting plants operated in the United States in 1928

State	Name and address of operator	Location of plant	Date put in operation	Raw fuel used
Eastern States:				
Maryland	Anthracite Fuel Corporation, Eighth Street and Fait Avenue, Baltimore, Md.	Baltimore	1925	Anthracite and bituminous slack.
Massachusetts	Salem Briquette Co., Salem, Mass.	Salem	1927	Anthracite.
New Jersey	Anthracite Manufacturing Co., 500 Brunswick Avenue, Trenton, N. J.	Trenton	1918	Do.
Do	Navicoal Corporation, 1421 Chestnut Street, Philadelphia, Pa.	Keasbey	1925	Anthracite and bituminous slack.
Pennsylvania	American Briquet Co., 1505 Philadelphia Bank Building, Philadelphia, Pa.	Lykens	1920	Anthracite.
Do	Anthracite Briquette Co., Sunbury, Pa.	Sunbury	1919	Do.
Do	Parlass Coal Co., Forty-seventh Street and Parschall Avenue, Philadelphia, Pa.	Deibler	1928	Do.
Do	Philadelphia & Reading Coal & Iron Co., Twelfth and Market Streets, Philadelphia, Pa.	North Manheim Township.	1927	Do.
Virginia	Delparen Anthracite Briquette Co., Parrott, Va.	Parrott	1915	Virginia semianthracite.
Do	Old Dominion Anthracite Corporation, 1848 Straus Building, Chicago, Ill.	Pulaski	[1] 1926	Anthracite and bituminous slack.
Do	Virginia Fuel Corporation, P. O. Box 505, Norfolk, Va.	Portlock	1923	Do.
West Virginia	West Virginia Super Fuel Co., 712 Park Building, Pittsburgh, Pa.	Moundsville	1927	Semicoke.[2]

[1] Plant formerly operated by Empire Collieries Co.
[2] The residue of low-temperature carbonization of bituminous coal.

Briquetting plants operated in the United States in 1928—Continued

State	Name and address of operator	Location of plant	Date put in operation	Raw fuel used
Central States:				
Missouri	Standard Briquet Fuel Co., 818 Security Building, St. Louis, Mo.	Kansas City	1909	Arkansas semianthracite.
Wisconsin	Berwind Fuel Co., 122 South Michigan Avenue, Chicago, Ill.	Superior	1912	Semibituminous slack.
Do	Stott Briquet Co., Merchants National Bank Building, St. Paul, Minn.	do	1909	Anthracite fines and bituminous slack.
Do	United Coal & Dock Co., 8 Wells Street, Milwaukee, Wis.	Milwaukee	1928	Bituminous slack.
Pacific Coast States:				
California	San Diego Gas & Electric Corporation, Electric Building, San Diego, Calif.	San Diego	1925	Carbon (petroleum residue).
Oregon	Portland Gas & Coke Co., 206 Sixth Street, Portland, Oreg.	Portland	1913	Do.
Washington	Northwestern Briquetting Co., 607 Burke Building, Seattle, Wash.	Ravensdale	1928	Bituminous slack and subbituminous coal.
Do	Pacific Coast Coal Co., 612 L. C. Smith Building, Seattle, Wash.	Renton	1914	Coking bituminous slack and free-burning slack.
Do	Wilkeson Coal & Coke Co., Wilkeson, Wash.	Fairfax	1926	Bituminous slack.

CAPACITY OF PLANTS

The hourly capacity of the plants operated in 1928 is shown in the following table. Since over one-half of the plants worked from 18 to 24 hours during the busy season the measurement of capacity on an hourly basis affords a good indication of potential output. In 1928 the smallest plant had a capacity of approximately 2½ tons per hour and the two largest a capacity exceeding 75 tons. When operating three shifts a day, as is the practice at the height of the winter demand, each of the two largest plants had a capacity of over 1,800 tons every 24 hours.

Classification of briquet plants, by hourly capacity in 1928

Capacity per hour	Number of plants
Less than 5 net tons	2
5 and less than 10	6
10 and less than 25	6
25 and less than 50	5
50 and less than 75	-----
75 net tons and over	2
	21

Hourly capacity, however, is only partly reflected in total annual production because of the seasonal and variable character of operations at some of the works. Consequently a more accurate conception of the prevailing size of briquetting plants may be obtained by grouping them according to their production in 1928, as shown by the table that follows. Out of 21 plants 5 produced less than 2,000 tons each; 5 produced between 2,000 and 5,000 tons; and 5 turned out between 10,000 and 25,000 tons. In 1928, as in 1926 and 1927, the output of two plants exceeded 200,000 tons.

Classification of briquet plants, by size of output in 1928

Output	Number of plants
Less than 2,000 net tons	5
2,000 and less than 5,000	5
5,000 and less than 10,000	1
10,000 and less than 25,000	5
25,000 and less than 100,000	2
100,000 and less than 200,000	1
200,000 net tons and over	2
	21

By adding together the maximum monthly tonnage produced by each of the 21 plants in 1928 a total of 142,500 tons is obtained It may therefore be stated that the briquetting plants of the country have a demonstrated capacity, with existing labor force and working conditions, of at least 142,500 tons a month, or 1,710,000 tons a year.

HOURS OPERATED PER DAY

As previously noted a majority of the plants active in 1928 reported that they worked two or three shifts a day during the busy season. Eleven plants, producing 89 per cent of the total output, operated 18 or more hours a day. The 10 plants working 5 to 11 hours a day contributed only 11 per cent of the total production.

Classification of briquet plants, by number of hours operated per day during busy season in 1928

Hours per day	Number of plants	Production (net tons)
18 to 24 hours	11	841, 924
5 to 11 hours	10	105, 499
	21	947, 423

RAW FUELS

Sources.—In the questionnaire for 1928 the producers were asked to give the "source of raw fuel made into briquets." The purpose of this inquiry was to determine whether the raw fuel used was produced primarily for briquetting purposes or whether it was a by-product. The replies show that approximately 30 per cent of the total raw fuel used in 1928 was silt from coal-washing operations at mines, 23 per cent was screenings from dry preparation of larger sizes, 22 per cent was fines resulting from breakage in transit, 17 per cent was culm from banks at the mines, and 8 per cent was from other sources (Welsh anthracite, "river coal," screenings from wet preparation of larger sizes, and carbon residue from oil-gas manufacture). It is of interest that "river coal," dredged from streams which drain the Pennsylvania anthracite region, supplied all of the raw fuel for two briquet works and was used in combination with other raw coal by a third plant.

Kinds.—A total of 940,806 net tons of raw fuel of all kinds was briquetted in 1928; 40 per cent of this amount was anthracite and semianthracite, 52 per cent semibituminous and bituminous coal (including small amounts of semicoke), and 8 per cent subbituminous coal and carbon residue from the manufacture of oil gas. As the weight of binders added was greater than the weight of the moisture expelled there was a net gain of 6,617 tons during the process of manufacture.

Raw fuels used in making briquets in the United States, 1923–1928, in net tons

Fuel	1923	1924	1925	1926	1927	1928
Anthracite culm and fine sizes and semianthracite	331,102	224,539	387,454	426,064	359,438	376,257
Semibituminous and bituminous slack and semicoke [1]	225,508	297,814	341,161	456,546	502,686	489,323
Subbituminous coal and oil-gas residue	125,880	[2] 61,012	115,975	88,525	88,684	75,226
	682,490	583,365	844,590	971,135	950,808	940,806

[1] Includes no semicoke, 1923–24.

[2] Includes no subbituminous coal.

In 1928 anthracite and semianthracite fines were used either alone or in combination with other raw coal as a fuel constituent by 13 works. The character of the raw fuel used by the 21 plants was as follows:

Classification of briquet plants, by kinds of raw fuel used in 1928

Kind of raw fuel used	Number of plants
Anthracite fines	6
Semianthracite fines	2
Mixture of anthracite fines and bituminous slack	5
Bituminous or subbituminous slack	4
Semibituminous fines	1
Semicoke (low-temperature coke or char)	1
Carbon residue from the manufacture of oil gas	2
	21

Nine plants reported that from a small portion to all of the raw coal used was washed either by the colliery operator or the briquet manufacturer to reduce the percentage of ash in the finished briquets. Much of the Pennsylvania anthracite briquetted in 1928 was washed, but less than one-fourth of other raw fuel was so prepared.

BINDERS

There were no radical changes in binders in 1928. Asphaltic pitch was employed as a binder, either alone or in combination, by 13 out of 21 active plants. Eight producers used it exclusively, 2 used asphaltic pitch and coal-tar pitch, 1 a mixture of asphaltic pitch and patent binder, 1 asphaltic pitch and molasses residue, 1 asphaltic pitch and starch, 1 coal-tar pitch, 2 sulphite liquor, 1 sulphite cellulose, and 2 patent binders. Two plants briquetting carbon residue from oil gas required no binder.

Five of the producers using a binder, whose total output was 25,757 tons, reported that they recarbonized the briquets coming from the presses to drive off smoke from the binder.

The percentage of binder to raw fuel, by weight, ranged from less than 5 to 9 per cent or more. The proportion most commonly used was 5 or 6 per cent.

Classification of briquet plants, by percentage of binder used in 1928

Binder used	Number of plants
Using no binder (carbon residue)	2
Using—	
Less than 5 per cent binder	1
5 and less than 7 per cent	9
7 and less than 9 per cent	5
9 per cent and over	4
	21

FOREIGN TRADE IN BRIQUETS

Imports of fuel briquets in 1928 were 71,485 net tons, an increase of 10,884 tons or 18 per cent over 1927. Due to the demand for household fuels created by the anthracite shortages of 1922–23 and 1925–26 the European product was introduced into the New England market. Despite abundant supplies of anthracite during the past two years the volume of briquet imports, although less than the record of 123,593 tons established in 1926, has persisted at a high level in comparison with former years.

According to the customs records, 69,618 tons, or about 97 per cent of the 1928 imports, were discharged at or in the vicinity of Boston, 91 tons were discharged at New York, and 6 tons at San Francisco; Maine and New Hampshire received 1,734 tons, and the State of Washington 36 tons. Of the total imports 67,694 tons, or 94.7 per cent, came from Germany and Netherlands, 3,625 tons from the United Kingdom, 95 tons from France, 37 tons from Canada, and 34 tons from Belgium.

Briquets and other composition coals for fuels imported for consumption in the United States, 1919–1928 [1]

Year	Net tons	Value	Year	Net tons	Value
1919	136	$1,050	1924	38	$443
1920	(2)	9	1925	6,758	43,931
1921	66	251	1926	123,593	736,804
1922	34,862	139,382	1927	60,601	314,435
1923	19,559	103,201	1928	71,485	353,168

[1] Compiled by J. A. Dorsey, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.

[2] 112 pounds.

WORLD PRODUCTION

How small a part of the world output of briquets is contributed by the United States is shown in the following table. In round numbers the total production is now about 52,000,000 metric tons, of which Germany contributes about 87 per cent. France and Belgium are the second and third largest producers, and their combined output is about one-seventh of the German tonnage. The quantity of briquets produced in Netherlands and Spain most closely approximates the output of plants in the United States.

The briquetting industry has attained its greatest development in countries where a large part of the available coal is of low grade and is unsuitable for use in its raw state. In Germany the production of lignite briquets has increased 36.6 per cent during the past five years. In 1928, when the production of German lignite was

166,224,159 metric tons, approximately 79,500,000 metric tons was briquetted, and the output of lignite briquets was 40,158,478 metric tons.

World production of fuel briquets, 1924–1928, in metric tons

[Compiled under supervision of L. M. Jones, of the Bureau of Mines]

Country[1]	1924	1925	1926	1927	1928
Algeria	79, 265	74, 495	57, 442	83, 338	(2)
Belgium	2, 030, 310	2, 237, 171	2, 142, 660	1, 688, 970	1, 961, 000
Czechoslovakia:					
Coal	75, 710	156, 477	181, 797	160, 254	214, 579
Lignite	175, 613	211, 884	197, 211	211, 770	241, 316
France	5, 427, 105	5, 781, 037	6, 142, 355	3, 904, 160	4, 061, 838
Germany:[3]					
Coal	4, 359, 476	5, 590, 613	5, 901, 593	4, 968, 511	4, 906, 980
Lignite	29, 399, 746	33, 663, 447	34, 358, 043	36, 459, 237	40, 158, 478
Saar	------------	------------	746	285	(2)
Great Britain	1, 208, 610	1, 243, 090	850, 774	1, 502, 053	(2)
Hungary:					
Coal	27, 535	32, 412	21, 847	18, 653	20, 100
Lignite			36, 990	23, 888	22, 300
Indo-China	76, 211	89, 820	97, 456	119, 700	(2)
Netherlands	562, 181	570, 717	675, 405	662, 210	(2)
Netherland East Indies	28, 373	22, 644	96, 159	112, 543	(2)
Poland	444, 231	375, 100	239, 160	252, 776	(2)
Spain	627, 014	670, 974	686, 707	803, 127	548, 143
United States	526, 591	761, 460	902, 945	880, 389	859, 483
Venezuela	3, 475	2, 043	2. 399	2, 297	(2)
	45, 051, 446	51, 483, 384	52, 591, 689	51, 854, 161	(2)

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[1] In addition to the countries listed, briquets are produced in Victoria, Australia, but data of output are not available; the plant started operations in November, 1924.

[2] Data not available.

[3] Exclusive of the Saar.

FLUORSPAR AND CRYOLITE

By Hubert W. Davis

FLUORSPAR

Fluorspar (or fluorite) is a nonmetallic crystalline mineral that usually occurs in glassy, transparent, isometric crystals, largely cubic, or in cleavable masses. Less commonly it has a granular or fibrous structure, and occasionally it is banded. Fluorspar has a specific gravity of 3.2, is brittle, has a hardness of 4, and can be scratched easily with a knife. It is a mineral of many colors, ranging from clear, colorless, or slightly bluish, and glasslike through various striking hues, of which purple and green are most common; much of it is white and opaque. Chemically it consists of calcium and fluorine in the proportion of 51.1 to 48.9.

The outstanding feature in the fluorspar industry in 1928 was the increase, effective November 16, 1928, from $5 to $7.50 a short ton in the rate of duty on fluorspar that contains not more than 93 per cent of calcium fluoride. Other features in the fluorspar industry in 1928 were the substantially increased domestic shipments (the largest since 1922); the decreased imports, chiefly from Germany and the United Kingdom (the smallest since 1923); the resumption of fluorspar mining in Nevada; and the greatly increased domestic production of acid-grade fluorspar (the largest since 1920 and more than four times that in 1927).

PRODUCTION AND SHIPMENTS

Shipments of fluorspar to steel plants by domestic producers were 16 per cent more in 1928 than in 1927, and there were increases of 9 and 24 per cent, respectively, in the shipments of fluorspar to manufacturers of glass and enamel. The increased shipments of acid-grade fluorspar from domestic mines in 1928 are noteworthy, being equivalent to about 78 per cent of the total fluorspar consumed in the United States in 1928 in the manufacture of hydrofluoric acid, whereas shipments of domestic acid-grade fluorspar in 1927 were equivalent to only about 24 per cent of the total. Shipments of fluorspar for use in the manufacture of Portland cement amounted to 951 short tons in 1928, and though small in comparison with shipments for other uses represent substantial increases over the corresponding figures for 1927 and 1926. The sales of domestic fluorspar for use in foundries decreased, and the exports of fluorspar were about the same as in 1927.

In 1928 shipments of fluorspar from domestic mines aggregated 140,490 short tons, valued at $2,656,554, an increase of 25 per cent in quantity and of 31 per cent in total value as compared with 1927. The general average value for all grades in 1928 per ton f. o. b. mines or shipping points was $18.91, 83 cents more than the 1927 average. The value recorded for the domestic fluorspar is the price paid f. o. b. mine shipping point by the consumer and excludes the cost of containers. The increase in the general average value in 1928 is due to the larger proportion and higher selling price of acid-grade fluorspar. The general average value of the fluorspar shipped to steel plants in 1928 from the Illinois-Kentucky district was $15.27 a ton and from the Colorado-New Mexico district $12.19 a ton. This difference in average values represents chiefly economic factors in marketing rather than differences in quality of fluorspar from these two districts.

The table that follows presents such details of the shipments of fluorspar for 1925 to 1928, by States, as may be published without revealing statistics of individual producers except by permission.

Fluorspar shipped from mines in the United States, 1925–1928

State	Gravel			Lump			Ground			Total		
	Short tons	Value		Short tons	Value		Short tons	Value		Short tons	Value	
		Total	Average		Total	Average		Total	Average		Total	Average
1925												
Colorado	10, 560	$137, 343	$13. 01	1, 216	$16, 364	$13. 46	----------	----------	----------	11, 776	$153, 707	$13. 05
Illinois	46, 195	783, 451	16. 96	3, 366	115, 814	21. 13	4, 867	$308, 881	$32. 25	54, 428	1, 024, 516	18. 82
Kentucky	39, 153	669, 672	17. 10	1, 176			4, 497			44, 826	833, 794	18. 60
New Mexico	1, 487	20, 817	14. 00	939			213			2, 639	40, 325	15. 28
	97, 395	1, 611, 283	16. 54	6, 697	132, 178	19. 74	9, 577	308, 881	32. 25	113, 669	2, 052, 342	18. 06
1926												
Illinois	47, 254	812, 129	17. 19	1, 780	108, 710	20. 54	4, 700	363, 713	32. 26	53, 734	1, 012, 879	18. 85
Kentucky	53, 386	912, 525	17. 09	2, 641			6, 467			62, 494	1, 167, 129	18. 68
New Mexico	1, 063	144, 200	12. 59	820			106			1, 989	161, 269	12. 98
Colorado	10, 389			51			----------	----------	----------	10, 440		
	112, 092	1, 868, 854	16. 67	5, 292	108, 710	20. 54	11, 273	363, 713	32. 26	128, 657	2, 341, 277	18. 20
1927												
Illinois	38, 970	656, 863	16. 86	2, 471	105, 062	21. 18	4, 565	330, 356	31. 31	46, 006	863, 909	18. 78
Kentucky	50, 533	839, 933	16. 62	1, 454			5, 508			57, 495	1, 040, 338	18. 09
New Mexico	1, 562	102, 514	13. 61	574			477			2, 613	130, 481	14. 43
Colorado	5, 971			461			----------	----------	----------	6, 432		
	97, 036	1, 599, 310	16. 48	4, 960	105, 062	21. 18	10, 550	330, 356	31. 31	112, 546	2, 034, 728	18. 08
1928												
Illinois	56, 555	876, 819	15. 50	4, 066	161, 603	26. 12	5, 263	368, 417	29. 99	65, 884	1, 154, 983	17. 53
Kentucky	62, 528	1, 212, 760	19. 40	1, 428			5, 791			69, 747	1, 426, 766	20. 46
New Mexico	961	36, 955	12. 58	399			1, 229			2, 589	74, 805	15. 40
Colorado	1, 562			253			----------	----------	----------	1, 815		
Nevada	415			40			----------	----------	----------	455		
	122, 021	2, 126, 534	17. 43	6, 186	161, 603	26. 12	12, 283	368, 417	29. 99	140, 490	2, 656, 554	18. 91

HISTORY OF PRODUCTION

The accompanying table presents statistics of the production of fluorspar by States, beginning with 1880. The record of production before 1880 was not obtained, and the statistics for Kentucky and Colorado are incomplete for certain years after 1880, so that more fluorspar has been mined than the table shows. The unrecorded output must be small, however, since the advantages of fluorspar over limestone as a flux in basic open-hearth steel plants have been generally recognized only since about 1899. Before that time fluorspar was used mainly in the preparation of hydrofluoric acid and in the manufacture of opalescent glass, consequently the demand was small.

The production of fluorspar by years for 1880 to 1904, a brief discussion of the history of mining in the different States, and estimates of unrecorded output in early years are given in Mineral Resources, 1925, Part II, pages 9 to 14.

Fluorspar produced[1] in the United States, 1880–1928, by States

Year	Arizona		Colorado		Illinois		Kentucky		Nevada		New Hampshire		New Mexico		Tennessee		Utah		Washington		Total	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1880–1904	654	$6,593	------	------	169,870	$1,037,399	134,186	$740,467	------	------	------	------	------	------	400	$3,400	------	------	------	------	305,110	$1,787,859
1905	------	------	1,156	$8,200	33,275	220,206	22,694	132,362	------	------	------	------	------	------	260	1,720	------	------	------	------	57,385	362,488
1906	------	------	300	1,800	28,268	160,623	11,868	79,802	------	------	------	------	------	------	360	1,800	------	------	------	------	40,796	244,025
1907	------	------	3,300	11,400	25,128	141,971	21,058	133,971	------	------	------	------	------	------	------	------	------	------	------	------	49,486	287,342
1908	34	252	701	4,266	31,727	172,838	6,323	48,642	------	------	------	------	------	------	------	------	------	------	------	------	38,785	225,998
1909	30	435	350	2,100	41,852	232,251	7,800	53,233	------	------	------	------	710	$3,728	------	------	------	------	------	------	50,742	291,747
1910	------	------	268	1,608	47,302	277,764	17,003	124,574	------	------	------	------	4,854	26,250	------	------	------	------	------	------	69,427	430,196
1911	------	------	721	4,226	68,817	481,635	12,403	96,574	------	------	800	$6,400	4,307	22,612	------	------	------	------	------	------	87,048	611,447
1912	------	------	1,639	9,834	103,937	695,467	10,473	61,186	------	------	300	1,500	196	1,176	------	------	------	------	------	------	116,545	769,163
1913	100	800	4,432	26,592	85,854	550,815	19,622	113,903	------	------	200	1,200	5,372	42,976	------	------	------	------	------	------	115,580	736,286
1914	------	------	1,978	12,992	73,811	426,063	19,077	128,986	------	------	250	2,000	------	------	------	------	------	------	------	------	95,116	570,041
1915	------	------	247	1,482	116,340	624,040	19,219	129,873	------	------	650	5,200	485	3,880	------	------	------	------	------	------	136,941	764,475
1916	199	2,587	8,669	42,457	126,369	746,150	19,698	123,596	------	------	800	7,864	------	------	------	------	------	------	------	------	155,735	922,654
1917	135	1,080	17,104	196,633	156,676	1,373,333	43,639	697,566	------	------	1,274	19,110	------	------	------	------	------	------	------	------	218,828	2,287,722
1918	364	5,537	38,475	416,780	132,798	2,887,099	87,604	2,069,185	------	------	1,059	21,243	3,437	64,348	------	------	20	$465	60	$824	263,817	5,465,481
1919	45	450	9,687	150,739	92,729	2,430,361	32,386	883,171	400	$5,600	531	12,826	2,346	37,643	------	------	166	4,784	------	------	138,290	3,525,574
1920	181	3,264	12,852	251,308	120,299	3,096,767	46,091	1,246,942	532	8,672	202	4,040	6,353	101,460	------	------	268	6,094	------	------	186,778	4,718,547
1921	------	------	3,143	39,907	12,477	315,767	15,266	294,513	------	------	567	13,721	3,507	60,186	------	------	------	------	------	------	34,960	724,094
1922	------	------	2,309	20,169	83,855	1,493,188	52,484	970,059	------	------	690	15,353	2,180	30,992	------	------	78	1,404	------	------	141,596	2,531,165
1923	------	------	6,044	59,710	65,045	1,443,490	45,441	945,402	------	------	142	3,160	4,328	50,861	------	------	188	3,196	------	------	121,188	2,505,819
1924	------	------	12,301	135,411	62,067	1,288,310	47,847	988,940	------	------	------	------	2,580	35,178	------	------	184	3,292	------	------	124,979	2,451,131
1925	------	------	11,776	153,707	54,428	1,024,516	44,826	833,794	------	------	------	------	2,639	40,325	------	------	------	------	------	------	113,669	2,052,342
1926	------	------	10,440	[2]161,269	53,734	1,012,879	62,494	1,167,129	------	------	------	------	1,989	(2)	------	------	------	------	------	------	128,657	2,341,277
1927	------	------	6,432	[2]130,481	46,006	863,909	57,495	1,040,338	------	------	------	------	2,613	(2)	------	------	------	------	------	------	112,546	2,034,728
1928	------	------	1,815	[2]74,805	65,884	1,154,983	69,747	1,426,766	455	(2)	------	------	2,589	(2)	------	------	------	------	------	------	140,490	2,656,554
	1,742	20,998	156,139	[2]1,917,876	1,898,548	24,151,824	926,744	14,530,974	1,387	[2]14,272	7,465	113,617	50,485	[2]521,615	1,020	6,920	904	19,235	60	824	3,044,494	41,298,155

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[1] Beginning with 1906 figures represent shipments from mines.

[2] Value for New Mexico for 1926, 1927, and 1928 and for Nevada for 1928 included with Colorado.

SHIPMENTS, BY USES

The table that follows shows the relative dependence of the fluorspar industry on the different industries in which fluorspar is used. The predominance of the steel industry as a purchaser of fluorspar is evident. The high value of fluorspar for hydrofluoric acid, glass, and enamel is due to the high quality demanded.

Fluorspar shipped from mines in the United States, 1927–28, by uses

Use	1927				1928			
	Percentage	Short tons	Value		Percentage	Short tons	Value	
			Total	Average			Total	Average
Steel	82.81	93,196	$1,523,915	$16.35	76.92	108,064	$1,641,190	$15.19
Foundry	4.03	4,533	84,724	18.69	2.63	3,694	66,215	17.93
Glass	5.30	5,968	184,450	30.91	4.63	6,499	195,885	30.14
Enamel and vitrolite	3.39	3,813	119,888	31.44	3.35	4,713	142,495	30.23
Hydrofluoric acid and derivatives	3.33	3,748	98,364	26.24	11.35	15,946	585,092	36.69
Miscellaneous	.80	903	15,880	17.59	.84	1,176	19,091	16.23
	99.66	112,161	2,027,221	18.07	99.72	140,092	2,649,968	18.92
Exported	.34	385	7,507	19.50	.28	398	6,586	16.55
	100.00	112,546	2,034,728	18.08	100.00	140,490	2,656,554	18.91

INDUSTRY IN 1928, BY STATES

COLORADO

The shipments of fluorspar from Colorado mines in 1928 amounted to 1,815 short tons, a decrease of 72 per cent from 1927 and the smallest shipments since 1915. Of the 1928 total, 1,667 tons was for use in basic open-hearth steel plants and the remainder, 148 tons, for use in foundries.

In 1928 practically all of the fluorspar produced in Colorado was from mines in the Jamestown district, Boulder County, and most of it was sold to the Lehman mill, in which it was prepared for the market.

A carload of fluorspar was mined at the Blue Spar mine in Custer County and shipped to the steel plant at Pueblo, Colo.

A small quantity of high-grade fluorspar was mined and shipped in the course of development at the Blue Stone claim in Gilpin County, near Tolland.

The Wagon Wheel Gap mine, 1¼ miles southwest of Wagon Wheel Gap, in Mineral County, which has been the chief producing mine in Colorado as well as in the West, was inactive during 1928. However, a carload of fluorspar from stock pile was shipped to Pueblo, Colo.

The names and addresses of the shippers of fluorspar from Colorado in 1928 are as follows:

Shippers of fluorspar from Colorado in 1928

Colorado Fuel & Iron Co	Denver, Colo.
Lehman, E. W	Jamestown, Colo.
McMahon, P. S	Tolland, Colo.

ILLINOIS

In 1928 about 117,200 short tons of fluorspar-bearing rock, equivalent to about 62,300 tons of merchantable fluorspar, was mined at nine mines or prospects in Illinois. The quantity of fluorspar milled in Illinois in 1928 aggregated about 115,000 short tons, from which was recovered about 60,000 tons of merchantable fluorspar—a loss of about 55,000 tons in milling and a ratio of 1.917:1. In 1928 the shipments of fluorspar from Illinois to consumers amounted to 65,884 short tons, an increase of 43 per cent over 1927; of the total about 14,000 tons was moved to destination by Ohio River. The fluorspar shipped from Illinois in 1928 was reported distributed among the various industries as follows:

Distribution among the various industries of fluorspar from Illinois in 1928

Industry:	Short tons
Steel	54, 891
Foundry	1, 850
Glass	2, 603
Enamel	2, 256
Hydrofluoric acid	4, 086
Miscellaneous	122
Exported	76
	65, 884

The Daisy mine on the Daisy vein was again the largest producer of fluorspar in Illinois. The output of this mine was supplemented by some production from the Eurekas mine on the north extension of the Rosiclare vein, which has been in the exploration and development stage. The output of crude ore from these mines in 1928 was 34 per cent greater than in 1927. Although 17 per cent more crude ore was milled than in 1927, the quantity of finished product recovered was 4 per cent less, due to the mining and treating in 1928 of a lower grade of crude ore than in 1927. This has necessitated more efficient mill practice. During the first part of 1928 mill practice at the Rosiclare mill, in which the ore from the Daisy and Eurekas mines is treated, was changed from a single day shift to day and night shifts. On the day shift a No. 1 grinding gravel containing 95 to 98 per cent of CaF_2 and a No. 3 or middling gravel containing about 75 per cent CaF_2 are produced from the jigs. The No. 3 or middling gravel is remilled on the night shift, when a further tonnage of high-grade grinding gravel is extracted. This practice permits the recovery of a much higher percentage of high-grade material, which commands a better market price. In connection with the change in operating practice two new jigs and rolls, elevators, hummer screens, and bins were installed to clean the high-grade concentrate. Exploration and development accomplished at the Daisy and Eurekas mines in 1928 were moderately successful and maintained ore reserves ahead of mining operations, although the grade of crude ore is somewhat lower than in the past. The shipments of fluorspar from these mines in 1928 were about 32 per cent more than in 1927.

The Hillside mine on the eastern extension of the Rosiclare vein was worked on a greatly increased scale in 1928. The shaft at this mine is being sunk to the 550-foot level, where the finding of good ore has been reported.

The mines of the Franklin Fluorspar Co. in Illinois were again nonproductive; this company centered its activities in Kentucky, where it has a number of mines and a well-equipped mill at Marion. A small quantity of mill tailings was shipped from stock at the Franklin mill during 1928.

The Rose mine in Hardin County, Ill., 7½ miles north of Rosiclare, was opened in July, 1928; the small quantity of fluorspar produced was sold to the mills at Marion, Ky.

At the Spar Mountain mine, 5 miles northeast of Cave in Rock, Ill., the production of crude ore in 1928 increased 98 per cent over 1927, but sales increased only 58 per cent. More than half of the fluorspar shipped from this mine in 1928 went to destination by the Ohio River, near which is located the mill where the ore is treated. The construction of a new concentrator was started in November, 1928.

A small quantity of fluorspar was produced and shipped from the Lead Hill mine, in Hardin County, 4 miles northwest of Cave in Rock.

Development was continued during 1928 at the property of Outwater, Schwerin & Barnett, in Hardin County, 8 miles northeast of Elizabethtown, Ill., where the sinking of a shaft was started in September, 1927, and ore was reached in December, 1927. A headframe and ore bins were installed in 1928, and the shaft was timbered. The entire production in 1928, amounting to several thousand tons, came from drifts and crosscuts driven in the course of development. This deposit is described in an article by Schwerin.[1]

The operators of the Empire and Knight mines, in Pope County, near Eichorn, shipped about twice as much fluorspar in 1928 as in 1927. They purchased and shipped a considerable quantity of fluorspar that had been stocked at the mine of the Douglas Fluorspar Mines Co. and also acquired a 5-year lease on all of the Douglas holdings in Pope and Hardin Counties.

A list of producers and shippers of fluorspar in Illinois in 1928, with their post-office addresses, follows.

Producers and shippers of fluorspar in Illinois in 1928

Benzon Fluorspar Co	Cave in Rock, Ill.
Franklin Fluorspar Co	Paducah, Ky.
Hamilton, C. R.	Cave in Rock, Ill.
Hillside Fluor Spar Mines	Chicago, Ill.
Knight, Knight & Clark	Rosiclare, Ill.
Outwater, Schwerin & Barnett	Elizabethtown, Ill.
Roberts & Frazer	Marion, Ky.
Rosiclare Lead & Fluorspar Mining Co	Cleveland, Ohio.

KENTUCKY

In 1928 fluorspar-bearing rock equivalent to about 69,000 short tons of merchantable fluorspar was mined from 29 mines and prospects in Kentucky, and shipments of fluorspar from Kentucky to consumers amounted to 69,747 short tons, an increase of 21 per cent over 1927. The shipments were the second largest recorded for the State and for the fourth time since 1904 exceeded those of Illinois. The shipments of fluorspar from Kentucky in 1928 were distributed among the industries as follows:

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[1] Schwerin, Martin, An Unusual Fluorspar Deposit: Eng. and Min. Jour., vol. 126, Sept. 1, 1928, pp. 335–339.

Distribution among the various industries of fluorspar from Kentucky in 1928

Industry:	Short tons	Industry—Continued.	Short tons
Steel	50, 090	Portland cement	951
Foundry	1, 297	Miscellaneous	103
Glass	3, 513	Exported	322
Enamel	1, 885		
Hydrofluoric acid	11, 586		69, 747

Caldwell County.—In Caldwell County, in which the deposits of fluorspar occur east and southeast of Fredonia and north and northwest of Princeton, about 7,700 short tons of run-of-mine fluorspar were produced in 1928, as compared with about 6,000 tons in 1927.

The chief producing mine in Caldwell County in 1928 was the Crook mine, 4 miles north of Crider, from which about 7,000 short tons of run-of-mine fluorspar were produced. A mill for treating the fluorspar from the Crook mine was completed at Crider in July, 1928.

At the Marble property, about 4 miles east of Fredonia, about 200 short tons of merchantable fluorspar were recovered in 1928.

At the Tyrie prospect, about 3 miles north of Princeton, 188 short tons of crude fluorspar were mined, of which 118 tons were treated in the Lafayette mill near Mexico, Ky., and yielded 61 tons of merchantable fluorspar.

A small quantity of fluorspar was mined at the Walker mine, 3 miles north of Crider, where operations were started in 1927.

Crittenden County.—In 1928 the Franklin Fluorspar Co. worked, more or less, the Mary Belle, Memphis, Split Nickel, Loveless, Susie Beeler, Beard, Cross, and Franklin mines, 5 to 15 miles from Marion, and the Haffaw, Brown, Hodge, and Redd mines, 1 to 4½ miles from Mexico, Ky. In addition, the company purchased the entire output of the Davenport mine and some of the output of the Watson, Guill, and Nancy Hanks mines. The Haffaw mine, which has been one of the important producers in the Kentucky field, was exhausted in 1928, and the mill near Mexico, Ky., in which the ore has been treated, was being dismantled at the end of 1928. The company, however, has a well-equipped mill at Marion, where the ore from all of its Kentucky mines will be milled in future. Production in 1928 at the mines of the company in Kentucky was 37 per cent greater than in 1927, and the sales were 30 per cent greater.

At the Watson (or Liberty Bond) mine, 7 miles southwest of Marion, some development, including the sinking of shafts, was done; consequently, the production was only about half that of 1927. Most of the product sold from this mine in 1928 was of acid grade and was shipped for use in the manufacture of hydrofluoric acid. The remainder comprised both fluxing and grinding grades; most of it was sold to the local mills.

Production at the mines of the Lafayette Fluorspar Co., near Mexico, Ky., was about the same in 1928 as in 1927, but the shipments increased 25 per cent. Development and mining progressed during 1928 at the Tabb No. 1, Tabb No. 2, and Wheatcroft shafts on and above the 250, 270, and 200 foot levels, respectively. A jig was added to the mill and preparations were made for further alterations in the concentrating plant at Tabb No. 1 shaft. A log washer, an elevator, a boiler, and a hoist were installed at Tabb No. 2 shaft.

The Lucile mine, a short distance south of the railroad station at Marion, produced about the same quantity of fluorspar in 1928 as in 1927 and 1926. At this mine a new shaft was sunk to a depth of 120 feet, through which a considerable tonnage of high-grade white fluorspar was mined. At the old workings the shaft was sunk from the 175 to the 230 foot level, drifts with the vein were extended for a distance of about 250 feet, and a connection was driven to the new workings.

In 1928, as in 1927, the entire output of the Davenport mine, 8 miles from Marion, was sold to the Franklin mill at Marion. The work done in 1928 was mostly development; consequently, the output was much less than in 1927. The main shaft was sunk from the 150 to the 190 foot level, from which a crosscut of 20 feet was driven to new ore. An old 80-foot shaft at this mine was reopened, and a level was driven 100 feet south along the vein, disclosing a new ore shoot of fluorspar analyzing about 95 per cent of calcium fluoride after log washing.

The Kentucky Fluorspar Co., which has a mill a short distance south of the station at Marion and adjoining the Lucile mine, did 5 per cent less business, by volume, than in 1927; fluxing grades comprised 54 per cent and ground fluorspar 46 per cent of its sales in 1928. This company does not operate any mines, but buys part or all of the output of many local mines and prospects. In 1928 the company obtained its supply chiefly from the Lucile, Crook, Nancy Hanks, Watson, Crystal, Blue & Marble, Reiter, Marble, and Walker mines in Kentucky and from the Empire and Knight mines in Illinois.

Operations at the Blue & Marble mine, 1 mile south of Mexico, were suspended by the former operators, and the lease to the mine was surrendered. R. C. McMaster & Co. acquired a lease of the mine for the period October 28, 1928, to December 31, 1931, and also leased the mill from the former operators. A small quantity of fluorspar was mined by the new operators in 1928, and some fluorspar from stock pile was shipped by the former operators.

The Pigmy mine, three-fourths of a mile south of the railroad station at Mexico, Ky., inactive since the latter part of 1919, was reopened in September, 1928, and yielded several hundred tons of fluorspar. One of the old shafts was cleaned out for 100 feet, of which 50 feet was retimbered, and a crosscut was driven 75 feet into an ore body, where levels were driven with the ore for about 150 feet. New shafts have been sunk to depths of 50 to 75 feet. Five shafts are producing fluorspar at this mine.

The Keystone mine, 5 miles west of Marion, and the Two Brothers mine, 10 miles southwest of Marion, both inactive for some time, were being reopened in 1928. Work was started during October, 1928, at the Edwards prospect, 5 miles from Marion, and two prospect shafts were sunk about 30 feet each; a fairly good ore shoot was found.

A small quantity of fluorspar was taken from shallow depths at the Reiter prospect, 5 miles west of Mexico, Ky., and some surface fluorspar, together with a small quantity from underground, was produced at the Standard mine, 6 miles southwest of Marion.

Livingston County.—In Livingston County four mines were worked in 1928; they produced about 16,000 short tons of crude fluorspar, as compared with about 3,500 tons produced by six mines in 1927.

One of the chief producers in this county in 1928 was the Klondike mine, 6 miles southwest of Salem and 7 miles northeast of Smithland, reopened in 1928 after several years of inactivity. About 10,000 short tons of run-of-mine ore was produced in 1928, from which about 3,100 tons of merchantable fluorspar was recovered, practically all of fluxing grade. The fluorspar from this mine is barged from Smithland on the Cumberland River to Brookport, Ill., where it is transferred to railroad cars.

The Guill mine, 1½ miles north of Salem, was worked on a much larger scale in 1928 than in 1927. The ore from this mine is of high grade and finds a ready market. Most of that mined in 1928 was sold to the Franklin mill at Marion. The shaft at the Guill mine is being sunk from its present depth of 200 to 300 feet.

The Nancy Hanks mine, 1½ miles southeast of Salem and 13 miles southwest of Marion, produced about the same quantity of fluorspar in 1928 as in 1927; all of it was sold to the mills at Marion.

A small quantity of fluorspar was mined in the course of development work at the Loveless property, 13 miles southwest of Marion.

The list that follows contains the names and addresses of the chief operators of fluorspar mines and mills in Kentucky.

Operators of chief fluorspar mines or mills in Kentucky

Crook, S. L., & Co	Princeton, Ky.
Eagle Fluor Spar Co	Salem, Ky.
Franklin Fluorspar Co	Paducah, Ky.
Gugenheim Mining Co	Marion, Ky.
Haynes, W. V	Do.
Holly Fluorspar Co	Do.
Independent Fluorspar Co	Do.
Kentucky Fluorspar Co	Do.
Lafayette Fluorspar Co	Duluth, Minn.
McMaster, R. C., & Co	Mexico, Ky.
Oglebay Norton & Co	Cleveland, Ohio.

NEVADA

Mining operations were resumed in 1928 at the Daisy mine 4½ miles southeast of Beatty in Nye County, and a little more than 400 tons of run-of-mine fluorspar was shipped to Pacific coast steel plants. This mine was first opened in 1918; shipments amounting to 932 tons were made during 1919 and 1920, but no further shipments were made until May, 1928.

A carload of fluorspar was shipped to a Pacific coast steel plant in 1928 from the Baxter prospect, 5½ miles from Broken Hills, in Mineral County. As yet no effort has been made to do any systematic mining, the output being obtained by gouging from a streak on the footwall. The cost of mining at present is said to be only $2.50 a ton. A serious handicap to production, however, is the distance of 75 miles from the mine to Fallon, the railroad shipping point; the cost of hauling the fluorspar from the mine to Fallon is said to be $8 a ton. The fluorspar is reported to be of high grade—25 samples taken along 3,300 feet of the ledge for a width of two feet reported as averaging 98.55 per cent of calcium fluoride, 0.61 per cent of calcium carbonate, and a trace of sulphur. The carload shipped in 1928 from the Baxter prospect is said to have carried 99 per cent of calcium fluoride.

Producers and shippers of fluorspar in Nevada in 1928

Crowell, J. Irving, jr	Beatty, Nev.
Fluorite Producers	Stockton, Calif.

NEW MEXICO

The shipments of fluorspar from New Mexico in 1928 aggregated 2,589 short tons, only slightly less than the shipments of 2,613 tons in 1927. The shipments in 1928 were distributed among the industries as follows:

Distribution among the various industries of fluorspar from New Mexico in 1928

Industry:	Short tons
Steel	961
Foundry	399
Glass	383
Enamel	572
Hydrofluoric acid	274
	2, 589

The greater part of the fluorspar mined in New Mexico in 1928 was obtained from prospects in Dona Ana County near Las Cruces. The ore from these prospects was hauled to the Tortugas mill, near Mesilla Park, where it was prepared for the market.

The Tortugas mine, which has been the largest producer of fluorspar in New Mexico, was not worked during 1928.

The Heathden (or Tonuco) mine, in Dona Ana County, 1 mile from Heathden and 6 miles south of Rincon, was operated on a small scale and a little fluorspar was shipped.

The shipments of fluorspar from the Hot Springs mine, 4½ miles south of Hot Springs, Sierra County, were more than five times those of 1927. All the fluorspar shipped in 1928 was ground; 80 per cent of it was sold to manufacturers of glass and enamel, and the remainder was sold for use in the manufacture of hydrofluoric acid. The operators of the Hot Springs mine report a demand in 1928 in excess of their ability to produce with present mill equipment.

The Lyda K mine, in Sierra County, 24 miles north of Hatch, the shipping point, produced about 1,000 tons of crude ore in 1928. A mill in which to treat the ore from this mine was started in 1926, but in the course of construction a number of changes were found necessary and the mill was not completed until 1928, when a small quantity of ground fluorspar was produced. The mill did not prove satisfactory, however, and further improvements are planned during 1929.

The fluorspar deposits and mines in New Mexico have been described by Johnston.[2]

Producers and shippers of fluorspar from New Mexico in 1928 were as follows:

Producers and shippers of fluorspar from New Mexico in 1928

Brazeal, J. E	Rincon, N. Mex.
Fluor Spar Mines of America	Hot Springs, N. Mex.
Hayner & Manasse	Las Cruces, N. Mex.
Southwest Fluorite Co	Do.

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[2] Johnston, W. D., jr., Fluorspar in New Mexico: New Mexico Bureau of Mines and Mineral Resources Bull. 4, Socorro, 1928.

STOCKS AT MINES OR SHIPPING POINTS

According to the reports of producers, the total quantity of fluorspar in stock at the mines or at shipping points at the close of 1928 was 72,618 short tons, an increase of 2 per cent over 1927. These stocks consisted of 12,162 tons of ready-to-ship fluorspar and of 60,456 tons of crude fluorspar still to be milled which was calculated to be equivalent to 35,000 tons of ready-to-ship fluorspar. As the quantity of fluorspar in stock piles must be partly estimated, the mine reports vary from year to year, preventing an absolute balance between the quantity mined and that shipped and in stock.

Certain stocks of fluorspar reported as on hand in Arizona and Colorado at the close of 1927, but which are at present noncommercial, have been disregarded in compiling the following table. Stocks in Nevada at the close of 1927, which were considerably overestimated, have been adjusted accordingly.

Stocks of fluorspar at mines or shipping points in the United States, 1927–28, by States, in short tons

State	1927			1928		
	Crude[1]	Ready-to-ship	Total	Crude[1]	Ready-to-ship	Total
Arizona	[2] 150	225	[2] 375	150	225	375
Colorado	[2] 180	40	[2] 220	295	56	351
Illinois	5,075	14,710	19,785	7,322	8,278	15,600
Kentucky	42,043	8,057	50,100	51,461	3,473	54,934
Nevada	(3)	(3)	(3)	80		80
New Mexico	460	90	550	1,100	130	1,230
Texas	48		48	48		48
	[2] 47,956	[2] 23,122	[2] 71,078	60,456	12,162	72,618

[1] The greater part of this crude (run-of-mine) fluorspar must be beneficiated before it can be marketed.
[2] Revised figures.
[3] Stocks reported for 1927 have been dropped from the record.

IMPORTS AND EXPORTS[3]

The total imports of fluorspar into the United States in 1928 amounted to 47,183 short tons, valued[4] at $408,700, and were the smallest since 1923. The imports in 1928 showed a decrease of 34 per cent in quantity and of 31 per cent in total value from 1927. The value assigned to the foreign fluorspar in 1928 averaged $8.66 a ton. The cost to consumers in the United States includes, in addition, the duty, loading charges at the docks, the ocean freight, and other charges, besides the freight from docks to manufacturers' plants.

The imports were equivalent to 34 per cent of the total shipments of domestic fluorspar in 1928, as compared with 64 per cent in 1927.

Complete information is not available as to the uses for which foreign fluorspar was imported, but reports furnished by importers covering about 73 per cent of the total imports in 1928, together with other information and estimates, indicate the following distribution:

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[3] Figures on imports compiled by J. A. Dorsey, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce; those on exports supplied by the producers. No exports of fluorspar recorded by the Bureau of Foreign and Domestic Commerce.

[4] "The value of imported merchandise * * * is the foreign value or the export value, whichever is higher—that is, the market value or the price at which the merchandise, at the time of exportation to the United States, is offered for sale in the principal markets of the country from which exported, including the cost of containers or coverings and all expenses (including any export tax) incident to placing the merchandise in condition ready for shipment to the United States, as defined in section 402 of the tariff act of 1922."

Uses for which foreign fluorspar was imported in 1928

[Partly estimated]

	Short tons
Steel and iron	41, 383
Glass and enamel	2, 500
Hydrofluoric acid	3, 300
	47,183

As shown in the foregoing statement, and as is well known in the industry, the greater part of the imported fluorspar is of fluxing grade and is used in the steel industry. According to reports of the importers of 31,083 short tons of the imported fluorspar sold to steel manufacturers in 1928, the selling price of this quantity at tidewater, duty paid, averaged $15.80 a short ton.

The selling price of imported ground fluorspar, which was sold to manufacturers of glass and enamel, averaged $34.47 a short ton at tidewater, duty paid.

The United Kingdom, which from 1922 to 1926 was the chief source of imported fluorspar, supplied only 20 per cent of the total imported in 1928. The imports (9,360 short tons) therefrom in 1928 represented a decrease of 49 per cent from 1927. Practically all the fluorspar from this source in 1928 was sold for use in the steel industry.

As in 1927, Germany was the chief source of imported fluorspar in 1928 and supplied 37 per cent of the total; the imports, however, were 45 per cent less than in 1927. Although most of the fluorspar imported from Germany in 1928 was of fluxing grade, that country was also the chief source of imported ground fluorspar. Some acid-grade fluorspar was also imported from Germany in 1928.

The imports of fluorspar from France in 1928, amounting to 15,072 short tons, were about 29 per cent more than in 1927. Most of the fluorspar from France was sold for use in basic open-hearth steel plants.

The Union of South Africa, which since 1923 has been the chief source of imported acid-grade fluorspar, supplied only 2,661 short tons in 1928, as compared with 7,069 tons in 1927.

The imports of fluorspar from Italy increased from 449 short tons in 1927 to 1,033 tons in 1928; all of the fluorspar imported in 1928 was ground material and was sold to manufacturers of glass and enamel.

President Coolidge, exercising the authority vested in him by section 315 of the tariff act of 1922, issued on October 17, 1928, a proclamation effective 30 days later changing the rate of duty on fluorspar that contains not more than 93 per cent of calcium fluoride from $5.60 per long ton ($5 per short ton) to $8.40 per long ton ($7.50 per short ton). The increase is based on an investigation made by the United States Tariff Commission to ascertain the differences in costs of production of fluorspar in the United States and in the principal competing countries. Some of the results of this investigation have been published by the United States Tariff Commission.[5]

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[5] United States Tariff Commission, Fluorspar—Costs of Production: June 21, 1927.

The distances that domestic fluorspar must be transported by rail from mines to steel plants in the Lehigh and Susquehanna Valleys of Pennsylvania are much greater than the distances that foreign fluorspar must be moved from the ports of entry to these plants, so that comparatively little domestic fluorspar is sold to steel plants in this area. Moreover, a large part of the imported material is carried as ballast, making possible a lower market price than would have to be charged if it were carried as a primary cargo. However, foreign fluorspar is not generally of such high grade as the mechanically cleaned domestic product, and, as the value of fluorspar depends mainly upon its purity, comparison of American with foreign fluorspar should be made not merely on the basis of price per ton but on quality as well.

Fluorspar imported into the United States, 1927–28, by countries

[General imports]

Country	1927			1928		
	Short tons	Value		Short tons	Value	
		Total	Average		Total	Average
Argentina	-------	-------	-------	20	$360	$18.00
Belgium	21	$449	$21.38	-------	-------	-------
Canada	560	4,250	7.59	-------	-------	-------
China	449	3,961	8.82	756	8,200	10.85
France	11,711	86,279	7.37	15,072	141,434	9.38
Germany	31,829	230,821	7.25	17,601	150,872	8.57
Italy	449	5,969	13.29	1,033	9,600	9.29
Spain	978	3,650	3.73	680	5,178	7.61
Union of South Africa	7,069	90,966	12.87	2,661	36,471	13.71
United Kingdom	18,449	168,840	9.15	9,360	56,585	6.05
	71,515	595,185	8.32	47,183	408,700	8.66

Producers of fluorspar reported exports in 1928 amounting to 398 short tons, valued at $6,586, or $16.55 a ton, as compared with 385 tons, valued at $7,507, or $19.50 a ton, in 1927. All of the fluorspar exported in 1928 went to Canada.

Fluorspar reported by producers as exported from the United States, 1920–1928

Year	Short tons	Value		Year	Short tons	Value	
		Total	Average			Total	Average
1920	2,764	$65,475	$23.69	1925	1,055	$17,574	$16.66
1921	-------	-------	-------	1926	2,132	34,915	16.38
1922	2,296	40,966	17.84	1927	385	7,507	19.50
1923	1,144	25,312	22.13	1928	398	6,586	16.55
1924	617	14,489	23.48				

USES

The uses of and specifications for fluorspar are discussed in greater detail in Mineral Resources, 1926, Part II, pages 30 to 34.

Metallurgical industries.—Fluorspar has many uses, but the most important is in the manufacture of steel by the basic open-hearth process. It is also used in the manufacture of alloy steel and ferro-alloys by the electric furnace process and in some foundry and other metallurgical operations.

Ceramic industries.—Fluorspar is used in considerable quantities in the glass industry, chiefly for the manufacture of opal or opaque and colored glass; as an ingredient in enamels for various purposes; and in the manufacture of cement, in which it is said that the addition of fluorspar to the raw materials permits the lowering of the fusing point, resulting in considerable economy in fuel, as well as economy in power, because the clinker obtained is fragile and therefore more easily ground.

Chemical industries.—Fluorspar is the basic material used in the manufacture of hydrofluoric acid. It is also said to be used to facilitate the fusion and contact of ingredients in the manufacture of calcium carbide and cyanamid.

Optical fluorspar.—A very small quantity of clear fluorspar crystals is used for optical purposes; fluorspar is useful in correcting the color and spherical aberration errors in lenses, especially those of microscopes and small telescopes.

CONSUMPTION—STOCKS AT CONSUMERS' PLANTS

Figures on the consumption of fluorspar in 1927 and 1928 and on stocks at consumers' plants at the close of these years are given in the following table. Although these figures do not include data from all consumers, they are believed not to fall far short of the total for the United States. Thus, the figures for the basic open-hearth steel industry, the chief consumer of fluorspar, include actual figures from the 70 companies that make 99.4 per cent of the total basic open-hearth steel and estimates for the other 2 companies. Consumption by all the electric steel and ferro-alloy manufacturers who are known to use fluorspar is represented. The smaller foundries, some of which use a little fluorspar, are not all represented, so that the consumption and stocks for this industry are somewhat incomplete. The figures for fluorspar used in hydrofluoric acid for the two years represent actual figures for five companies and an estimate for one company. The consumption and stocks for the glass and enamel industries, although not representing all the consumers, do represent 112 companies and are believed to be practically complete, as these companies include all the larger and probably most of the smaller consumers.

Fluorspar consumed and in stock in the United States, 1927–28, by industries, in short tons

Industry	1927		1928	
	Consumption	Stocks at consumers' plants Dec. 31	Consumption	Stocks at consumers' plants Dec. 31
Basic open-hearth steel	138,000	85,000	152,000	76,000
Electric-furnace steel	4,700	1,200	6,100	1,300
Foundry	3,400	1,000	3,300	1,000
Ferro-alloys	500	100	800	400
Hydrofluoric acid and derivatives	15,500	13,000	20,500	11,000
Enamel and vitrolite	5,800	800	5,700	900
Glass	6,800	900	6,200	1,200
Miscellaneous	1,500	400	1,600	600
	176,200	102,400	196,200	92,400

The average quantity of fluorspar used by individual plants per ton of basic open-hearth steel made varies widely, usually ranging from 1 to 35 pounds. In general, the average is between 7 and 8 pounds—a very small proportion of the furnace charge. The next table shows over a period of five years the variation in average consumption of fluorspar per ton of basic open-hearth steel in certain plants that make about 80 per cent of the total.

Average consumption of fluorspar per ton of steel, 1924–1928, in pounds

1924	1925	1926	1927	1928
19.295	13.983	12.959	13.315	12.211
7.409	7.893	8.219	7.074	6.761
6.857	6.224	5.700	6.100	5.640
5.365	4.809	6.270	7.067	6.253
5.383	4.568	4.313	4.862	4.181
7.652	9.090	11.225	7.261	4.865
8.747	8.656	8.541	8.572	8.204
8.055	4.992	4.862	4.561	5.875
5.075	7.037	5.523	4.225	4.726
7.350	5.719	6.692	6.320	7.648
6.172	6.684	6.020	7.643	7.637
5.425	5.551	4.289	4.487	6.156
14.178	15.007	8.440	11.509	10.766

The table that follows shows the relation of the consumption of fluorspar to the production of basic open-hearth steel for the five years from 1924 to 1928 and the stocks of fluorspar at such plants at the close of each of these years. The stocks of fluorspar at basic open-hearth steel plants at the close of 1928 were equivalent to a six months' supply, based on the consumption in 1928.

Consumption and stocks of fluorspar at basic open-hearth steel plants, 1924–1928

	1924	1925	1926	1927	1928
Production of basic open-hearth steel ....long tons..	30,719,523	37,087,342	39,653,315	37,144,268	43,200,483
Consumption of fluorspar in basic open-hearth steel production......short tons..	119,800	137,700	142,000	138,000	152,000
Consumption of fluorspar per ton of steel made..........................pounds..	7.8	7.4	7.2	7.4	7.0
Stocks of fluorspar on hand at steel plants at end of year...............short tons..	64,000	49,400	70,000	85,000	76,000

CONSUMERS

A directory of consumers of fluorspar in the United States, classified according to the industries in which the mineral is used and each industry arranged alphabetically by States and by location of consuming plant, is given in Mineral Resources, 1926, Part II, pages 38 to 45. The marketing of and markets for fluorspar are discussed in Mineral Resources, 1926, Part II, pages 35 to 38.

WORLD PRODUCTION

The following table was compiled by the Bureau of Mines from official sources as far as possible:

World production of fluorspar, 1924–1928, by countries, in metric tons

[Compiled by L. M. Jones, of the Bureau of Mines]

Country	1924	1925	1926	1927	1928
Australia:					
New South Wales	478	----------	-------	----------	----------
Queensland	1,894	4,295	2,348	1,050	1,143
Canada	69	3,525	----------	----------	----------
France	23,047	24,430	41,700	(1)	(1)
Germany:[2]					
Bavaria	21,663	31,454	32,475	51,001	(1)
Prussia	13,078	24,101	29,729	36,607	(1)
Saxony	9,032	16,141	17,442	22,027	(1)
Great Britain	50,286	39,706	36,459	40,362	(1)
Italy	6,831	7,770	6,320	5,577	4,420
Mexico	[3] 500	----------	937	(1)	(1)
Norway[4]	----------	5	----------	(5)	(1)
Russia[6]	215	1,211	3,765	840	(1)
Southwest African Protectorate	(1)	(1)	(1)	995	(1)
Spain	4,474	2,436	14,011	757	(1)
Union of South Africa	10,192	4,883	8,403	7,582	(1)
United States	113,378	103,118	116,715	102,099	127,450

[1] Data not available.

[2] In addition to the German States listed, fluorspar is produced in Baden and Thuringia, but data of output are not available.

[3] Estimated.

[4] Exports.

[5] Less than 1 ton (500 kilograms).

[6] Data for year ended Sept. 30.

CRYOLITE

Cryolite occurs in commercial quantities and is mined at only one place—Ivigtut, Greenland. The greater part of the product is shipped to Copenhagen, and the remainder is exported to the United States, from which some is reexported to Canada. Of the cryolite shipped to the United States, the greater part is used in the metallurgy of aluminum and for making opaque glass.

An article on the cryolite mine at Ivigtut was published in 1926 by Gordon.[6] He discusses the discovery, exploitation, and mining of cryolite and describes the geology and mineralogy of the deposit.

The imports of cryolite into the United States in 1928, according to the Bureau of Foreign and Domestic Commerce, amounted to 6,906 long tons, valued at $529,176, or $76.63 a ton, compared with 5,064 long tons, valued at $410,876, or $81.14 a ton, imported in 1927.

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[6] Gordon, S. G., Mining Cryolite in Greenland: Eng. and Min. Jour.-Press, vol. 121, Feb. 6, 1926, pp. 236-240.

CARBON BLACK

By G. R. Hopkins and H. Backus[1]

SUMMARY

The carbon-black industry continued to set new high records in 1928, when new marks were established for both production and sales. The total production of carbon black in 1928 amounted to 248,790,000 pounds, an increase over 1927 of 50,361,000 pounds, or 25 per cent, and the total sales for the year were 280,579,000 pounds, an increase over 1927 of 57,149,000 pounds, or 26 per cent. The production in 1928 had a total value at the plants of $13,782,000, or an average of 5.54 cents per pound; this represents little change in average value but, because of the sizeable increase in output, it represents a material gain in total value over 1927.

Stocks of carbon black held by producers at their plants continued to decline and on December 31, 1928, amounted to 50,240,000 pounds, as compared with 82,831,000 pounds on hand at the beginning of the year.

Of the total sales (280,579,000 pounds) of carbon black by producers in 1928, 77,903,000 pounds, or 28 per cent, was exported, leaving 202,676,000 pounds, or 72 per cent, as the domestic distribution, of which 140,938,000 pounds, or 70 per cent, was sold to rubber companies; 27,223,000 pounds, or 13 per cent, to ink companies; 20,040,000 pounds, or 10 per cent, to paint companies; and 14,475,000 pounds, or 7 per cent, for miscellaneous uses.

The rubber industry is by far the largest consumer of carbon black, and the major portion of the increase in carbon-black output in recent years has been due to the growth in the number of automobile tires manufactured. During 1928 the rubber industry produced about 75,000,000 automobile tires which, with a distribution of 140,938,000 pounds of carbon black, would indicate a consumption of nearly 2 pounds of carbon black per tire.

Louisiana again ranked first in the production of carbon black, with Texas second and Wyoming third. Louisiana with two less plants operating in 1928 than in 1927 produced 136,320,000 pounds of carbon black, as compared with 124,188,000 pounds in 1927, an increase of 10 per cent. The output in Texas rose from 56,396,000 to 100,828,000 pounds, an increase of 79 per cent; of the 1928 total for Texas, 64,927,000 pounds, or 64 for cent, was produced in the Panhandle district and 35,901,000, or 36 per cent, in the vicinity of Breckenridge. Louisiana and Texas together produced 95 per cent of the total output of carbon black in 1928. The year 1928 witnessed almost complete extinction of the carbon-black industry east of the Mississippi. In 1927 nine plants were in operation in Kentucky and West Virginia and produced 8,465,000 pounds of carbon black during the year; in 1928, however, the number of operating plants dropped to three and their output was only 1,181,000 pounds.

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[1] Figures on exports compiled by J. A. Dorsey, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.

Losses at the plants in 1928 amounted to 802,000 pounds, an increase over 1927 which was largely coincident with the increased output. Considerable progress has been made in recent years toward reducing the amounts of carbon black which drift away with the wind, and a few recent installations have been made concerning which it is stated that no perceptible amounts of carbon black are lost in this manner.

The producers of carbon black estimate that they burned 175,137,000,000 cubic feet of natural gas in 1928. This indicates an average recovery of 1.42 pounds of carbon black per thousand cubic feet of gas and compares with an average recovery of 1.38 pounds in 1927. This small yet important increase in average recovery in 1928 was probably due to improved methods.

Of the total output of carbon black in 1928, 220,532,000 pounds, or 89 per cent, was produced by means of the channel process and 28,258,000 pounds, or 11 per cent, by the thermatomic, Lewis, roller, disk, and "special" processes; this indicates a slight increase over 1927 in the proportion manufactured by the channel process.

The export trade in carbon black continued its rapid growth in 1928. Total exports for the year were 77,903,000 pounds, as compared with 54,431,000 pounds in 1927, an increase of 43 per cent. The exports in 1928 were valued at $6,794,000, or 8.72 cents per pound. The increase in exports in 1928 was distributed fairly evenly among the various countries. The United Kingdom continued to be the leading carbon-black customer of the United States, and was followed again, in order, by France, Germany, and Canada.

Summary of statistics of carbon black made from natural gas in the United States, 1924–1928

	1924	1925	1926	1927	1928
Number of producers reporting	46	42	33	33	31
Number of plants	69	63	62	61	65
Quantity produced:					
By States—					
Kentucky ... pounds	10, 135, 435	7, 309, 378	6, 309, 826	5, 669, 000	484, 000
Louisiana ... do	144, 601, 550	129, 839, 907	130, 376, 987	124, 188, 000	136, 320, 000
Texas ... do	13, 764, 014	26, 219, 510	36, 328, 052	56, 396, 000	100, 828, 000
West Virginia ... do	15, 045, 448	10, 847, 794	3, 804, 586	2, 796, 000	697, 000
Wyoming ... do	(1)	(1)	(1)	6, 294, 000	(1)
Other States ... do	3, 325, 587	3, 200, 789	3, 756, 725	3, 086, 000	10, 461, 000
Total ... do	186, 872, 034	177, 417, 378	180, 576, 176	198, 429, 000	248, 790, 000
By processes—					
Channel process ... do	162, 257, 725	143, 701, 153	152, 300, 410	167, 357, 000	220, 532, 000
Other processes [2] ... do	24, 614, 309	33, 716, 225	28, 275, 766	31, 072, 000	28, 258, 000
Stocks held by producers Dec. 31 ... do	95, 671, 246	96, 023, 448	108, 378, 101	82, 831, 000	50, 240, 000
Losses ... do	660, 836	1, 433, 850	716, 813	546, 000	802, 000
Quantity sold:					
Domestic ... do	(3)	132, 448, 691	128, 294, 321	168, 999, 000	202, 676, 000
Export ... do	(4)	43, 182, 635	39, 210, 389	54, 431, 000	77, 903, 000
Total ... do	128, 860, 766	175, 631, 326	167, 504, 710	223, 430, 000	280, 579, 000
Value (at plants) of carbon black produced:					
Total ... dollars	11, 564, 936	9, 639, 585	9, 939, 221	10, 955, 000	13, 782, 000
Average per pound ... cents	6. 19	5. 43	5. 50	5. 52	5. 54
Estimated quantity of natural gas used ... M cubic feet	156, 514, 000	140, 366, 000	130, 321, 000	144, 087, 000	175, 137, 000
Average yield per M cubic feet ... pounds	1. 19	1. 26	1. 39	1. 38	1. 42

Included under "Other States."
Including disk, Lewis, roller, "special," and thermatomic.
Figures not available.
Exports not separately recorded by Bureau of Foreign and Domestic Commerce prior to 1925.

PRODUCTION BY STATES AND DISTRICTS

Carbon black produced from natural gas in the United States, 1927–28, by States and by major producing districts

State and district	Producers reporting	Number of plants	Production			Estimated quantity of natural gas used (M cubic feet)	Average yield per M cubic feet (pounds)
			Pounds	Value at plant			
				Total	Average (cents)		
1927							
Kentucky	2	3	5,669,000	$247,000	4.36	3,187,000	1.78
Louisiana:							
Monroe district (Morehouse, Ouachita, and Union Parishes)	20	33	123,337,000	6,626,000	5.37	95,027,000	1.30
Rest of State (Caddo Parish)	1	1	851,000	34,000	4.00	1,123,000	.76
Total Louisiana	[1] 21	34	124,188,000	6,660,000	5.36	96,150,000	1.29
Montana	2	2	2,108,000	124,000	5.88	2,049,000	1.03
Texas:							
Breckenridge district (Eastland and Stephens Counties)	9	9	40,626,000	2,498,000	6.15	21,958,000	1.85
Panhandle district (Carson, Gray, Hutchinson, and Wheeler Counties)	3	4	15,770,000	801,000	5.08	13,537,000	1.16
Total Texas	[1] 10	13	56,396,000	3,299,000	5.85	35,495,000	1.59
Utah	1	1	978,000	49,000	5.01	891,000	1.10
West Virginia	5	6	2,796,000	207,000	7.40	1,921,000	1.46
Wyoming	2	2	6,294,000	369,000	5.86	4,394,000	1.43
Total United States	[1] 33	61	198,429,000	10,955,000	5.52	144,087,000	1.38
1928							
Kentucky	1	1	484,000	24,000	4.96	218,000	2.22
Louisiana:							
Monroe district (Morehouse, Ouachita, and Union Parishes)	19	31	136,183,000	7,359,000	5.40	104,523,000	1.30
Rest of State (Caddo Parish)	1	1	137,000	7,000	5.11	147,000	.93
Total Louisiana	[1] 20	32	136,320,000	7,366,000	5.40	104,670,000	1.30
Montana	2	2	2,084,000	123,000	5.90	1,760,000	1.18
Texas:							
Breckenridge district (Eastland and Stephens Counties)	8	9	35,901,000	2,268,000	6.32	19,077,000	1.88
Panhandle district (Carson, Gray, Hutchinson, and Wheeler Counties)	9	16	64,927,000	3,438,000	5.30	43,672,000	1.49
Total Texas	[1] 13	25	100,828,000	5,706,000	5.66	62,749,000	1.61
Utah	1	1	(2)	(2)	(2)	(2)	(2)
West Virginia	2	2	697,000	51,000	7.32	494,000	1.41
Wyoming	2	2	[2] 8,377,000	[2] 512,000	[2] 6.11	[2] 5,246,000	[2] 1.60
Total United States	[1] 31	65	248,790,000	13,782,000	5.54	175,137,000	1.42

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[1] In counting the total number of producers, a producer operating in more than one State, district, or county is counted only once.

[2] Utah included with Wyoming.

PRODUCERS

The following list shows the carbon-black producers of the United States as of January 1, 1929; the arrangement is alphabetical by State, company, and location of plant.

Carbon-black producers of the United States, as of January 1, 1929

State and company	County	Nearest town	Process
Louisiana:			
Carson Carbon Co., Post Office Box 880, Cincinnati, Ohio.	Morehouse	Collinston	Channel.
Century Carbon Co., Monroe, La	Ouachita	Swartz	Do.
Coltexo Corporation, 45 East Forty-second Street, New York, N. Y.	do	Hammock	Do.
Eastern Carbon Black Co. (United Carbon Co., owner), Post Office Box 1475, Charleston, W. Va.	Caddo	Greenwood	Channel and disk.
J. Smylie Herkness, Route No. 3, Bastrop, La	Morehouse	Bastrop	Channel.
J. M. Huber Co. of Louisiana (Inc.), 460 West Thirty-fourth Street, New York, N. Y.	Ouachita	Swartz	Do.
Imperial Oil & Gas Co., 1104 Union Bank Building, Pittsburgh, Pa.	do	Sterlington	Not reported.
Interstate Natural Gas Co. (Columbian Carbon Co., trustee), 45 East Forty-second Street, New York, N. Y.	Union	Spencer	Channel.
Keystone Carbon Co., Monroe, La	Ouachita	Monroe	Do.
Monroe-Louisiana Carbon Co., 45 East Forty-second Street, New York, N. Y.	do	Hancock	Do.
	do	do	Lewis.
North America Carbon Co., 301 Ardis Building, Shreveport, La.	do	Swartz	Channel.
Peerless Carbon Black Co., 1709 First National Bank Building, Pittsburgh, Pa.	do	Bourland	"Special."
Southern Carbon Co., 45 East Forty-second Street, New York, N. Y.	Morehouse	Perryville	Channel.
	do	Spyker	Do.
	Ouachita	Fairbanks	Do.
	do	Fowler	Do.
	do	Swartz	Do.
Texas-Louisiana Producing & Carbon Co., Post Office Box 181, Monroe, La.	do	Not reported (2 plants).	Not reported.
Thermatomic Carbon Co., 108 Ferry Street, Pittsburgh, Pa.	do	Sterlington	Thermatomic.
Tire Carbon Co., 1100 Merchants Building, Shreveport, La.	do	Swartz	Channel.
Union Gas Products Co., 714 Ouachita Bank Building, Monroe, La.	do	do	Light channel.
United Carbon Co., Post Office Box 1475, Charleston, W. Va.	Morehouse	Bastrop	Channel.
	do	Dewdrop	Do.
	do	Humphreys	Do.
	Ouachita	Cargas	Do.
	do	Phillips	Do.
	do	Swartz (2 plants)	Do.
U. S. Carbon Co., Bastrop, La	Morehouse	Bastrop	Do.
Montana:			
Crystal Carbon Co. (United Carbon Co., owner), Post Office Box 1475, Charleston, W. Va.	Stillwater	Molt	Do.
Gas Products Co., Baker, Mont	Fallon	Baker	Do.
Texas:			
Cabot Co., 940 Old South Building, Boston, Mass.	Carson	Skellytown	Channel and roller.
Coltexo Corporation, 45 East Forty-second Street, New York, N. Y.	Gray	Lefors	Channel
	Stephens	Parks	Do.
Crescent Carbon Co., Borger, Tex	Hutchinson	Borger	Do.
Eastern Carbon Black Co. (United Carbon Co., owner), Post Office Box 1475, Charleston, W. Va.	do	Borger (2 plants)	Do.
	do	Borger	Channel and disk.
General Atlas Chemical Co., Pampa, Tex	Gray	Pampa	"Special."
J. M. Huber Co. of Louisiana (Inc.), 460 West Thirty-fourth Street, New York, N. Y.	Stephens	Breckenridge (2 plants).	Channel.
Kosmos Carbon Co., (United Carbon Co., owner), Post Office Box 1475, Charleston, W. Va.	Hutchinson	Borger (2 plants)	Do.
Magnolia Petroleum Co., Dallas, Tex	Carson	Skellytown	Do.
	Gray	Pampa	Do.
	Stephens	Breckenridge	Do.
	Wheeler	Lela	Do.
Peerless Carbon Black Co., 1709 First National Bank Building, Pittsburgh, Pa.	Eastland	Pioneer	"Special."
Southern Carbon Co., 45 East Forty-second Street, New York, N. Y.	Gray	Pampa	Channel.

Carbon-black producers of the United States, as of January 1, 1929—Continued

State and company	County	Nearest town	Process
Texas—Continued.			
Texas Carbon Industries (Inc.), Breckenridge, Tex.	Stephens	Breckenridge (2 plants).	Channel.
Texas Elf Carbon Co., 940 Old South Building, Boston, Mass.	Gray	Pampa	Do.
Western Carbon Co., 45 East Forty-second Street, New York, N. Y.	Stephens	Eliasville	Do.
	Eastland	Pioneer	Do.
	Hutchinson	Borger	Do.
	Wheeler	Lela	Do.
Utah: Crystal Carbon Co. (United Carbon Co., owner), Post Office Box 1475, Charleston, W. Va.	Grand	Cisco	Do.
West Virginia:			
Columbian Carbon Co., 45 East Forty-Second Street, New York, N. Y.	Logan	Chapmanville	Do.
Imperial Oil & Gas Co., 1104 Union Bank Building, Pittsburgh, Pa.	Ritchie	Harrisville	Do.
Wyoming: J. M. Huber Co. of Louisiana (Inc.), 460 West Thirty-fourth Street, New York, N. Y.	Niobrara	Manville	Do.

EXPORTS

Carbon black exported from the United States, 1926–1928, by countries

Country	1926		1927		1928	
	Pounds	Value	Pounds	Value	Pounds	Value
Australia	1, 496, 699	$143, 855	2, 624, 908	$238, 083	3, 384, 455	$299, 112
Belgium	945, 839	89, 058	988, 363	84, 282	1, 212, 626	106, 742
Canada	4, 665, 295	360, 545	8, 988, 589	638, 560	11, 636, 500	794, 925
China	602, 721	54, 628	598, 914	49, 586	1, 153, 575	96, 153
France	9, 288, 361	857, 473	9, 796, 750	833, 980	14, 595, 631	1, 378, 392
Germany	4, 307, 441	403, 249	9, 299, 871	837, 418	13, 432, 720	1, 176, 069
Italy	2, 427, 619	232, 118	3, 158, 463	275, 491	3, 439, 691	312, 150
Japan	2, 816, 969	270, 545	3, 257, 831	288, 395	5, 549, 962	483, 450
Netherlands	492, 126	50, 262	1, 102, 116	100, 581	1, 947, 333	175, 707
United Kingdom	11, 010, 065	1, 039, 182	13, 200, 486	1, 116, 402	18, 887, 337	1, 721, 199
Other	1, 157, 254	121, 992	1, 414, 520	136, 956	2, 663, 323	250, 325
	39, 210, 389	3, 622, 907	54, 430, 811	4, 599, 734	77, 903, 153	6, 794, 224

FULLER'S EARTH

By Jefferson Middleton

GENERAL CONDITIONS

The fuller's earth industry continued to show progress in 1928; the product sold or used by producers in the United States increased both in quantity and value. The output of 1928—287,012 short tons, valued at $3,895,991—was reported by 17 operators, an increase of 1 operator compared with 1927. The quantity was the largest ever recorded, was 9 per cent greater than that of 1927, and was more than three times that of 1918. The value of the output was also the highest ever reported, was 3 per cent more than that of 1927, and was also more than three times that of 1918. The average value per ton in 1928 was $13.57, a decrease of 67 cents compared with that in 1927 but the same as that in 1918. The quantity of fuller's earth imported was practically the same in 1927 and 1928, imports in 1928 exceeding those in 1927 by only 13 tons. The total value of imported fuller's earth, however, increased $22,722, or 21 per cent, compared with 1927.

The apparent consumption of fuller's earth in the United States in 1928 was about 278,000 tons. The domestic earth used constituted 97 per cent of this total.

OCCURRENCE

Occurrences of fuller's earth have been reported in Alabama, Arizona, Arkansas, California, Colorado, Florida, Georgia, Illinois, Maryland, Massachusetts, Minnesota, Mississippi, Missouri, Nebraska, Nevada, New York, Pennsylvania, South Carolina, South Dakota, Texas, Utah, Virginia, and Washington, but in 1928 it was produced only in Arizona, Colorado, Florida, Georgia, Illinois, Massachusetts, Nevada, and Texas.

USES

Fuller's earth is used mainly as a filtering medium in clarifying or bleaching fats, greases, and mineral and vegetable oils. Its original use was in fulling woolen cloth, and from that it derived its name, but such use, at least in this country, has almost been abandoned. Fuller's earth is also said to be used in the manufacture of pigments for printing wall paper, in detecting certain coloring matters in some food products, as a substitute for talcum powder, and in medicine as a poultice and as an antidote for alkaloid poisons. Another suggested use is in deliming hides in the manufacture of leather. It has been stated that the fuller's earth cake from oil mills can be used in the manufacture of hand soaps, concrete waterproofing, and asphalt preparations.[1]

To within the past few years the term "fuller's earth" has been applied only to claylike materials that possess the property of bleaching, clarifying, decolorizing, or filtering mineral and vegetable oils and animal fats and greases. However, material discovered recently in the far West, which is of a different character but is said to be of excellent quality for filtering or clarifying oils, has been included in the figures in this report.

HISTORY

Fuller's earth was first discovered in the United States in 1891 near Alexander, Ark., by John Olsen. The mineral was used for a time by the Southern Cotton Oil Co., at Little Rock, Ark., but its use was finally abandoned.[2] The real beginning of the industry in this country, however, was in 1893, near Quincy, Fla., when quite by accident, in an unsuccessful effort to burn brick on the property of the Owl Cigar Co., an employee called attention to the close resemblance between the clay used and the German fuller's earth. This discovery in Florida caused considerable excitement, and deposits of fuller's earth were reported from a number of States, but the material in most of these deposits was found to have no value as fuller's earth. Production began in Florida almost immediately after the discovery, and from 1897 to 1899 fuller's earth was produced in Florida, Colorado, New York, and Utah. Florida maintained its rank as the leading producer continuously until 1924. In 1901 Arkansas again became a producer. From 1904 to 1907 Arkansas was the second largest producer, but no production of fuller's earth has been reported from Arkansas since 1922. Fuller's earth was found in Georgia soon after the discovery in Florida, but Georgia did not become a producer until 1907, when it ranked third as a producing State; it ranked second from 1909 to 1923, except in 1918 and 1919 when Texas was second; and since 1924 it has ranked first. In 1904 Alabama and Massachusetts, in 1907 South Carolina and Texas, in 1909 California, in 1918 Nevada, and in 1922 Illinois and Pennsylvania first appeared as producers. In 1928 Colorado reappeared as a producer of fuller's earth. Pennsylvania has reported no production since 1922.

PRODUCTION

Fuller's earth sold or used by producers in the United States, 1919–1928

Year	Operators reporting sales	Short tons	Value at mines		Year	Operators reporting sales	Short tons	Value at mines	
			Total	Average				Total	Average
1919	10	106,145	$1,998,829	$18.83	1924	13	177,994	$2,632,342	$14.79
1920	12	128,487	2,506,189	19.51	1925	14	206,574	2,923,965	14.15
1921	12	105,609	1,973,848	18.69	1926	14	234,152	3,356,482	14.33
1922	15	138,944	2,289,719	16.48	1927	16	264,478	3,767,038	14.24
1923	15	149,134	2,247,523	15.07	1928	17	287,012	3,895,991	13.57

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[1] Chemical and Metallurgical Engineering: Vol. 26, Mar. 29, 1922, p. 602.

[2] Branner, J. C., An Early Discovery of Fuller's Earth in Arkansas: Trans. Am. Inst. Min. Eng., vol. 43, pp 520–522, 1913.

The small number of producers in most of the States makes it impossible to publish totals for these States without revealing data for individual establishments. The output increased in quantity in every State except Georgia. The South continues to lead in the production of fuller's earth, Georgia, Florida, and Texas, named in the order of their relative importance, reporting 73 per cent of the output in 1928, compared with 76 per cent from these States in 1927 and 82 per cent in 1926. The increasing shipments of fuller's earth from Nevada, which in 1928 amounted to 45,157 tons, or 16 per cent of the total, account for the decreasing proportion of the total coming from the Southern States. In 1928 Georgia was again the leading State in quantity and value, reporting 100,406 tons, valued at $1,572,041, or $15.66 a ton; Florida again ranked second and Nevada was again third. These three States reported 77 per cent of the total in 1928. The quantity of fuller's earth sold or used by producers in Texas in 1928 was 33,388 tons, valued at $338,080, or $10.13 a ton, compared with 26,938 tons, valued at $283,400, or $10.52 a ton, in 1927, an increase of 24 per cent in quantity and 19 per cent in total value.

For the first time comparable information in regard to the uses to which the domestic fuller's earth is put may be published. The following table shows the result of the canvass for the two years for which such data were obtained. Only 1.4 per cent of the total output in 1928 and 2.3 per cent of that in 1927 was unclassified by the producers as to use.

Fuller's earth sold or used by producers in the United States, 1927–28, by uses

Year	Bleaching, clarifying, decolorizing or filtering—				Miscellaneous uses		Total (short tons)
	Mineral oils		Vegetable oils and animal fats				
	Short tons	Percentage of total	Short tons	Percentage of total	Short tons	Percentage of total	
1927	243,009	91.9	15,363	5.8	6,106	2.3	264,478
1928	258,645	90.1	24,288	8.5	4,079	1.4	287,012

IMPORTS AND EXPORTS

Imports of fuller's earth, which at one time constituted the entire supply, were increasing before the World War and reached their maximum in 1914; since that time the general trend has been downward. In 1925 and 1926 there were slight increases; in 1927 there was a considerable decrease in quantity and a smaller decrease in value; in 1928 the quantity was practically the same as that in 1927, but the total value increased 21 per cent. The average value per ton in 1928 was $17.38, the highest ever recorded. In 1928 wrought or manufactured earth constituted 95 per cent of both the total quantity and total value of fuller's earth imported

Exports of fuller's earth are not shown in the official records of the foreign commerce of the United States, but eight operators reported to the Bureau of Mines that they exported 16,494 short tons of fuller's earth in 1928 to Argentina, Canada, Cuba, England, Germany, Mexico, Russia, and Scotland. This is an increase of 34 per cent compared with 1927, and is the largest quantity ever reported by producers as having been exported.

Fuller's earth imported for consumption in the United States, 1919–1928 [1]

Year	Unwrought or unmanufactured			Wrought or manufactured			Total		
	Short tons	Value		Short tons	Value		Short tons	Value	
		Total	Average		Total	Average		Total	Average
1919	373	$4,301	$11.53	13,500	$185,410	$13.73	13,873	$189,711	$13.67
1920	1,518	19,793	13.04	17,497	202,100	11.55	19,015	221,893	11.67
1921	483	6,172	12.78	9,261	113,243	12.23	9,744	119,415	12.26
1922	607	7,413	12.21	9,962	128,282	12.88	10,569	135,695	12.84
1923	642	8,252	12.85	7,905	105,692	13.37	8,547	113,944	13.33
1924	296	3,385	11.44	7,006	89,103	12.72	7,302	92,488	12.67
1925	215	2,619	12.18	7,800	108,676	13.93	8,015	111,295	13.89
1926	158	2,290	14.49	8,940	121,384	13.58	9,098	123,674	13.59
1927	550	5,679	10.33	7,030	103,602	14.74	7,580	109,281	14.42
1928	354	6,710	18.95	7,239	125,293	17.31	7,593	132,003	17.38

[1] Compiled by J. A. Dorsey of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.

SLATE

By Oliver Bowles and A. T. Coons

CONDITIONS IN THE INDUSTRY

Slate sold by producers in the United States in 1928 was valued at $11,472,291, an increase of less than 1 per cent over the value for 1927. The quantity of slate sold in 1928, approximately 646,360 short tons, represented a decrease of nearly 7 per cent from 1927. The decrease was in the quantity of slate granules sold, as the total quantity represented by the other classes of slate products was practically the same as in 1927.

There was an increase of 3 per cent in the number of squares of roofing slate sold in 1928, compared with 1927, and an increase of 9 per cent in their total value; the average value per square in 1928 was $11.20, compared with $10.56 in 1927.

Total sales of mill stock in 1928 declined less than 1 per cent in quantity. The decreases were in slate for electrical use, 9 per cent; for blackboards and bulletin boards, less than 1 per cent; and for billiard-table tops, 27 per cent. Slate for structural use increased 5 per cent, the number of school slates increased 9 per cent, and slate reported for vaults and covers increased slightly. Slate for walk ways, flagstones, crosswalks, stepping-stones, and similar uses has steadily increased in production the last few years; an increase of 27 per cent over 1927 was reported for 1928.

Sales of crushed slate in the form of granules and slate flour were 10 per cent less in 1928 than in 1927; the average value was $5.96 a ton in 1928, compared with $6.04 a ton in 1926 and 1927. Other stone, chiefly a "greenstone" (an altered diabase) crushed into granules and sold in 1928, amounted to 107,830 short tons, valued at $667,435, as shown in the chapter of this series on "Stone."

The slate-quarrying companies that reported sales in 1928 numbered 113, or 5 less than in 1927. In New York and Vermont many small quarries are intermittently worked on a small scale for roofing slate. The product of these quarries is generally sold with that of some of the larger quarries, and much of it consists of "freak" or odd-colored slate of unusual size or thickness for use in special work.

As slate from many of the small producers is sold by the larger producing companies the possibility of duplication of returns must be considered in the compilation of operators' reports. In preparing this report special care has been taken to avoid duplication.

DEFINITION OF SLATE

The standard definition of slate established by the American Society for Testing Materials reads as follows: "A microgranular crystalline stone derived from argillaceous sediments by regional metamorphism, and characterized by a perfect cleavage entirely independent of original bedding, which cleavage has been induced by pressure within the earth." The perfect cleavage, which permits of its being split into smooth, thin sheets, is its most striking characteristic.

ORIGIN AND OCCURRENCE

Commercial slates have originated from sedimentary deposits consisting largely of clay. Under pressure of superimposed materials the clays have been compressed into laminated shales. The mountain-building forces ever at work in the earth's crust have folded and compressed the shales, and the intense pressure and high temperature have altered the original clay matter into extremely fine-grained mica, quartz, chlorite, and other minerals. The pressure has also changed the orientation of the flakelike grains, causing them to assume a parallel position lying at a more or less definite angle to the direction of pressure. This parallelism of the mineral grains gives to slate its characteristic slaty cleavage.

Although rocks commonly designated as slate are of common occurrence, as, for example, the "bone" or slate associated with coal, it is only in relatively few localities that slate of commercial quality appears. These localities are described in a later section of this report.

PHYSICAL PROPERTIES

High-grade slates, such as those commonly sold, possess low absorption and high tensile strength. The colors are quite variable, those in Virginia, Pennsylvania, Maryland, and Maine varying from light gray to blue black. The slates of New York and Vermont are chiefly red, green, purple, or variegated. Some slates retain their color for many years, whereas others change in color after exposure to the weather, although such color change may not indicate any deterioration. The color assumed on aging may, in fact, be more attractive than the original.

Slates consist of very stable and enduring minerals, and there are numerous records of high-grade slate roofs that have withstood the weathering of centuries without noticeable deterioration.

STRUCTURAL FEATURES OF SLATE

The most noteworthy structural characteristic of slate, as mentioned previously, is its slaty cleavage. Slates usually possess a second direction of splitting less pronounced than the slaty cleavage; it is known as "sculp" or "grain" and is usually vertical and approximately at right angles to the slaty cleavage. The third direction, in which there is no tendency to split, is known as the "hard way." Another characteristic feature of some slates, notably those of Pennsylvania, is known as "ribbon," which consists of dark bands crossing the slate surfaces. The ribbons represent variations in the original materials as they were laid down in successive beds. They mar the appearance of the slate for certain uses, and some of them contain minerals that are less enduring than the clear stock.

USES

Originally slate was employed almost entirely for roofing; although this is still an important use many others have been developed. Slate which is worked up into slabs of various sizes and shapes is classed under the general term of mill stock.

Blackboards and school slates constitute an important branch of mill-stock manufacture. Another important division of mill-stock manufacture includes such products as mantles, floor tiles, steps, risers, baseboards, window sills, lavatory slabs, billiard and other table tops, wainscoting, hearths, well caps, vats, sinks, laundry tubs, grave vaults, refrigerator shelves, flour bins, and dough troughs.

Various surface finishes are obtained by the so-called marbleizing process; this consists of repeated painting and baking. A more recent form of surface finish, known as "Struco," consists of spraying or printing the surface with a volatile lacquer. Very beautiful designs are possible for application to various forms of structural products, as well as to novelties, such as clocks, inkwells, paperweights, etc.

Slate is also manufactured into slabs for electrical switchboards. Such slate must be low in carbon and in iron-bearing minerals.

Slabs of slate of various colors and sizes are used more and more widely for ornamental floors and walks. Slate crushed to granular form is employed very widely in the manufacture of slate-surfaced composition roofing. Slate in pulverized form, known as slate flour, is used as a filler in paints, road asphalt-surface mixtures, roofing mastic, and various other products.

TECHNOLOGY

During recent years the slate industry has made long strides toward a better technique in quarrying and manufacture. A notable example is the substitution in Pennsylvania of wire saws for channeling machines in making the primary cuts in quarries. This equipment, introduced about three years ago by the Bureau of Mines in cooperation with the National Slate Association and some of the operators, has proved of great advantage in conserving slate, saving time, and reducing production costs. About 30 wire saws are now in use in slate quarries. The wire saw and its operation have been described in some detail in a recent bureau report.[1] Some interest has been shown in extending the use of the wire saw to the cutting of slate blocks in mills.

Several companies are now operating mills for the manufacture of roofing slate, at least two new ones having been placed in operation during 1928. Some companies have had great success with the mill method of manufacturing roofing slate, whereas others do not regard it with favor.

DETERMINATION OF PROPERTIES OF SLATE

Much progress was made during 1928 in the study of the chemical and physical properties of slate. Quite a number of independent studies were undertaken, chiefly under the auspices of Committee D–16 on Slate of the American Society for Testing Materials. The chief purposes in view are to establish efficient testing methods and to develop specifications that will tend to direct the various types of slate to the uses for which they are best adapted, thus insuring permanent and satisfactory service. Tests in progress or proposed at the present time have to do with strength, hardness, conductivity, color life, and resistance to weathering or chemical action. The Federal Specifications Board has undertaken the task of preparing a standard specification for roofing slate.

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[1] Bowles, Oliver, The Wire Saw in Slate Quarrying, Second Supplementary Report: Repts. of Investigations, Serial 2918, Bureau of Mines, March, 1929.

CAUSES OF LACK OF GROWTH

As may be noted from the table of slate production over a period of years, given on a following page, the industry made rapid strides for the four years following 1922, but for the past two years production has decreased appreciably. The lack of more consistent growth in the industry is due to various causes. It is to be attributed chiefly to the keen competition that slate must meet in every line of production. Various types of roofing are much more widely advertised than slate, and many of them are synthetic products that can be manufactured at low cost. Similarly, slate meets with numerous competitive materials in structural and electrical applications. The recent depression in the blackboard-slate market is due to a recession in school construction. For about 10 years after the war there was great activity in schoolhouse construction to catch up with building programs retarded by the war; that period of activity is, however, now past and such construction has returned to normal.

Another factor that retards progress is the lack of efficient selling and advertising agencies, those sections of the industry that are most lacking in this respect being the least prosperous at the present time. There is, however, evidence of a movement toward bettering this condition through the establishment of joint marketing agencies in some localities to bring about better contacts between producers, distributors, and roofing and setting contractors, thus promoting sales and insuring better service to ultimate consumers. Three such agencies have recently been established, as follows: The Unfading Roofing Slate Co. of Fair Haven, Vt., the Vermont Weathering Green Slate Co. of Granville, N. Y., and the Pennsylvania Slate Institute of Pen Argyl, Pa.

SLATE COSTS

About a year ago the Bureau of Mines undertook to study the cost of quarrying and manufacturing slate. The preliminary study made it apparent that there was great need of a more efficient and uniform system of cost accounting. The bureau is cooperating closely with slate operators in preparing standard cost forms, and it is believed that the general acceptance of these will be helpful to the industry in several ways.

PRODUCTION

The following tables show sales of slate, by uses, from 1919 to 1928. The total quantity and value given for each use are the totals of the reports of the quarrymen (not the selling agents), and the value is that f. o. b. quarry or nearest point of shipment. Some of the mill stock may ultimately be used for purposes other than those reported by the quarrymen.

Slate sold by producers in the United States, 1919-1928, by uses

[Value is at point of shipment]

Year	Roofing slate		Mill stock		Other uses [1] (value)	Total value
	Squares (100 square feet)	Value	Square feet	Value		
1919	454, 337	$3, 085, 957	7, 466, 000	$1, 782, 793	$1, 161, 898	$6, 030, 648
1920	396, 230	3, 524, 658	9, 910, 000	3, 147, 281	2, 054, 503	8, 726, 442
1921	348, 085	3, 197, 745	8, 970, 000	2, 719, 723	1, 404, 538	7, 322, 006
1922	479, 243	4, 069, 761	9, 276, 800	2, 899, 195	2, 207, 828	9, 176, 784
1923	507, 587	4, 582, 535	11, 109, 480	4, 159, 644	3, 334, 445	12, 076, 624
1924	469, 393	4, 626, 614	10, 009, 180	3, 922, 366	3, 227, 036	11, 776, 016
1925	494, 530	5, 084, 945	11, 077, 860	4, 231, 477	3, 258, 904	12, 575, 326
1926	465, 900	5, 079, 087	10, 278, 130	4, 191, 185	3, 082, 495	12, 352, 767
1927	468, 560	4, 949, 940	9, 287, 680	3, 519, 386	2, 911, 410	11, 380, 736
1928	483, 280	5, 411, 332	9, 220, 170	3, 408, 304	2, 652, 655	11, 472, 291

[1] Chiefly slate granules.

In approximating the tonnage for the different slate products given in the table that follows a specific gravity of 2.75 has been used as the basis of calculation, and thicknesses ranging from three-sixteenths inch to 2 inches to correspond to the averages for the several products. The calculation is made on the individual lots reported by each producer. The thickness of the individual slates sold—especially in New York and Vermont—has increased greatly in the last few years, owing to the demand for better roofs and for architectural effects. The weights of a square of slate as reported by the quarrymen ranged from 670 to 2,000 pounds.

Roofing slate, mill stock,[1] and slate granules (including slate "flour") sold by producers in the United States, 1927 and 1928, by uses

Use	1927		1928	
	Quantity	Value	Quantity	Value
Roofing ......squares	468, 560	$4, 949, 940	483, 280	$5, 411, 332
Approximate equivalent in short tons	176, 540	----------	177, 310	----------
Electrical ......square feet	1, 417, 060	1, 155, 502	1, 289, 060	1, 025, 386
Approximate equivalent in short tons	12, 420	----------	10, 990	----------
Structural and sanitary ......square feet	2, 420, 730	944, 577	2, 543, 470	1, 034, 818
Approximate equivalent in short tons	18, 760	----------	19, 990	----------
Grave vaults and covers ......square feet	530, 740	140, 947	532, 570	136, 836
Approximate equivalent in short tons	4, 920	----------	5, 060	----------
Blackboards and bulletin boards ......square feet	3, 735, 870	1, 116, 598	3, 713, 840	1, 079, 452
Approximate equivalent in short tons	10, 490	----------	9, 450	----------
Billiard-table tops ......square feet	402, 700	141, 764	293, 360	109, 221
Approximate equivalent in short tons	3, 450	----------	2, 550	----------
School slates ......pieces	1, 459, 100	19, 998	1, 584, 820	22, 591
Approximate equivalent in square feet	780, 580	----------	847, 870	----------
Approximate equivalent in short tons	900	----------	740	----------
Granules ......short tons	459, 760	2, 775, 962	413, 980	2, 468, 471
Other [2] ......short tons (estimated)	4, 800	135, 448	6, 290	184, 184
Total (quantities approximate, in short tons)	692, 040	11, 380, 736	646, 360	11, 472, 291

[1] Mill stock sold, including school slates, was as follows: 1927, 9,287,680 square feet, valued at $3,519,386; 1928, 9,220,170 square feet, valued at $3,408,304.

[2] Includes slate sold for flagging, crosswalks, stepping-stones, walk ways, etc. (726,300 square feet, valued at $132,095, in 1927 and 923,330 square feet, valued at $178,794, in 1928), tombstones, waste slate, and other uses not specified.

Slate sold by producers in the United States, 1927 and 1928, by States and uses

State	Operators	Roofing		Mill stock		Other uses (value)[1]	Total value
		Squares (100 square feet)	Value	Square feet	Value		
1927							
California	1	--------	--------	--------	--------	(2)	(2)
Georgia	1	--------	--------	--------	--------	(2)	(2)
Maine	3	(2)	(2)	(2)	(2)	(2)	$549, 952
Maryland	3	(2)	(2)	(2)	(2)	(2)	205, 812
New York	15	8, 210	$133, 608	--------	--------	$668, 829	802, 437
Pennsylvania	40	247, 120	1, 953, 076	7, 932, 180	$2, 409, 805	406, 551	4, 769, 432
Tennessee	1	--------	--------	--------	--------	(2)	(2)
Vermont	49	172, 490	2, 369, 300	797, 180	599, 476	1, 140, 135	4, 108, 911
Virginia	5	32, 580	398, 612	--------	--------	(2)	(2)
Undistributed [3]	--------	8, 160	95, 344	558, 320	510, 105	695, 895	944, 192
	118	468, 560	4, 949, 940	9, 287, 680	3, 519, 386	2, 911, 410	11, 380, 736
1928							
Arkansas	1	--------	--------	--------	--------	(2)	(2)
California	1	--------	--------	--------	--------	(2)	(2)
Georgia	1	--------	--------	--------	--------	(2)	(2)
Maine	3	(2)	(2)	(2)	(2)	(2)	551, 242
Maryland	3	(2)	(2)	(2)	(2)	(2)	187, 830
New York	15	21, 040	409, 821	1, 300	1, 040	641, 502	1, 052, 363
Pennsylvania	39	256, 540	2, 033, 588	7, 914, 110	2, 401, 696	351, 071	4, 786, 355
Tennessee	1	--------	--------	--------	--------	(2)	(2)
Vermont	43	161, 280	2, 423, 830	750, 510	502, 055	1, 056, 043	3, 981, 928
Virginia	6	37, 000	458, 153	--------	--------	(2)	(2)
Undistributed [3]	--------	7, 420	85, 940	554, 250	503, 513	604, 039	912, 573
	113	483, 280	5, 411, 332	9, 220, 170	3, 408, 304	2, 652, 655	11, 472, 291

[1] For details see table of general sales on p. 45 and table on pp. 50 and 51 for Pennsylvania.
[2] Included under "Undistributed."
[3] Includes output of States entered as "(2)" above.

IMPORTS AND EXPORTS [2]

Value of slate imported for consumption in the United States, 1919–1928

1919	$691	1924	$32, 095
1920	4, 512	1925	64, 570
1921	2, 923	1926	86, 681
1922	2, 753	1927	78, 909
1923	16, 881	1928	44, 778

Slate imported into the United States, 1925–1928, by countries

[General imports]

Country	1925		1926 (value)[a]	1927 (value)[a]	1928 (value)[a]
	Pounds	Value			
Austria	--------	--------	--------	--------	$5
Belgium	174	$15	$297	$282	1, 067
Canada	500	1, 359	21	5	1, 517
China	190	96	68	7	--------
Czechoslovakia	554	9	16	3	40
Denmark	39, 683	732	--------	--------	--------
France	63, 935	2, 044	29, 465	9, 450	11, 563
Germany	5, 008	386	9, 201	323	107
Gibraltar	--------	--------	--------	--------	30
Hong Kong	211	56	10	51	15
Italy	1, 677, 945	35, 601	43, 797	30, 069	16, 910
Japan	46	25	113	178	73
Netherlands	10	12	3	--------	--------
Norway	25, 575	1, 833	506	2, 040	1, 201
Portugal	735, 471	12, 652	6, 100	9, 029	9, 076
Spain	--------	--------	857	--------	--------
Sweden	21, 450	1, 515	--------	--------	--------
Switzerland	--------	--------	--------	1, 580	--------
United Kingdom	239, 226	8, 206	3, 143	21, 029	2, 738
	2, 809, 978	64, 541	93, 597	74, 046	44, 342

[a] Quantity not recorded.

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[2] The figures on imports and exports were compiled by J. A. Dorsey, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce, except as otherwise indicated.

About 35 per cent of the value of the slate imported in 1928 was represented by roofing slate, of which more than 72 per cent was the value of French slates; other roofing slate was reported, principally from Belgium, Norway, United Kingdom, and Germany. Somewhat less than one-half the value of the total imports was for slate in the form of slabs, chiefly from Italy and Portugal; Canada and the United Kingdom were also represented by slate of this class. Some blackboard material also was imported from Italy. A small part of the total value of imports was made up of unspecified products. No granules were among the imported materials.

Roofing slate exported from the United States, 1919–1928

Year	Number of squares	Value	Year	Number of squares	Value
1919	(1)	$55,164	1924	8,165	$77,422
1920	(1)	122,105	1925	5,785	54,130
1921	(1)	101,630	1926	5,621	53,117
1922	1,040	97,811	1927	6,798	80,171
1923	8,462	78,780	1928	12,236	119,187

[1] Quantity not recorded.

Roofing slate exported from the United States, 1926–1928, by countries

Country	1926		1927		1928	
	Number of squares	Value	Number of squares	Value	Number of squares	Value
Argentina	416	$4,016				
Canada	3,791	40,204	5,714	$70,974	6,642	$79,952
Mexico	522	1,548	92	1,270	85	300
Newfoundland and Labrador	70	840				
New Zealand	446	3,664	75	1,354		
Panama	111	832	38	848	154	1,330
Philippine Islands			10	83	126	172
United Kingdom			681	3,691	4,879	34,477
Virgin Islands of the United States					16	57
West Indies:						
British—						
Bermuda	45	286	31	421		
Trinidad and Tobago	110	1,100	66	659	222	1,440
Other	110	627	62	243	38	800
Cuba			29	628	74	659
	5,621	53,117	6,798	80,171	12,236	119,187

The following figures for exports of slate other than roofing slate were collected by the Bureau of Mines from shippers of the products named. Of the slate reported in this table all of the blackboard material was shipped to Canada, as was nearly one-half of the structural slate, over three-fourths of the electrical slate, about two-thirds of the slate used for billiard tables, and practically all of the granules. School slates were shipped to Canada and to other countries; India and Australia took the largest quantities in 1928. South America, West Indies, and Asia furnished markets for electrical slate and Mexico and South America for billiard-table slate. Small shipments of granules to Germany, England, and Porto Rico were reported.

Slate other than roofing exported from the United States, 1926–1928, by uses

Use	1926		1927		1928	
	Quantity	Value	Quantity	Value	Quantity	Value
School slates.......................cases[1]	11,210	$92,165	8,060	$76,333	14,320	$81,075
Electrical slate..............square feet	51,490	56,042	25,550	26,916	23,190	19,102
Blackboards..............................do	125,730	47,520	142,650	50,120	160,680	63,526
Billiard tables..........................do	46,730	37,903	55,350	37,341	65,620	45,010
Structural................................do	39,870	20,800	13,200	9,100	14,440	7,741
Slate granules..................short tons	7,620	46,000	11,360	67,000	13,990	82,140
	....	300,430	....	266,810	....	298,594

[1] Cases weigh from 130 to 165 pounds each; average is 135 pounds.

REVIEW BY DISTRICTS

The active slate-producing districts of the United States are the Monson district of Maine; the New York-Vermont district, including Washington County, N. Y., and Rutland County, Vt.; the Lehigh district, including Lehigh and Northampton Counties, Pa.; the Peach Bottom district, including Lancaster and York Counties, Pa., and Harford County, Md.; Berks County, Pa.; and the Buckingham County (Arvonia) and Albemarle County districts of Virginia. These districts produce roofing slate and mill stock; some of them also produce roofing granules and slate flour. Roofing granules and flour were also produced in California, Georgia, and Tennessee in 1928.

Maine.—The slate produced in the Maine district is sold chiefly for electrical work. Lesser amounts of slate from this district are sold for roofing and for structural work. There was a slight increase in the quantity of roofing slate sold in 1928, compared with 1927, but the sales of mill stock were practically the same for the two years. The producing companies in 1928 were The Monson Maine Slate Co. (address, 38 Chauncy Street, Boston, Mass.), the Portland-Monson Slate Co. (address, 25 Central Wharf, Portland, Me.), and the Rising & Nelson Slate Co. (address, West Pawlet, Vt.) (successors to the General Slate Co.), all with quarries at Monson. The Brownville-Maine Slate Co. (address, Presque Isle, Me.) recently purchased the "Crocker" quarry at Brownville but did not operate it in 1928.

New York-Vermont.—The New York-Vermont slate district is so continuous that it is sometimes difficult to determine from the reports of the producers to which State the product should be credited. These two States produce all of the colored slates used for roofing. Red slate is the chief product of the New York quarries, but they also produce, with those of Vermont, the various green, purple, variegated, mottled, and "freak" slates in demand for roofs.

The output of the New York quarries is for granules (red), roofing slate, and slabs for walk ways, flagging, etc. The principal producers of granules are the Advance Industrial Supply Co. (address, 111 West Washington Boulevard, Chicago, Ill.) and the J. B. Preston Co. (Inc.) (address, 122 East Forty-second Street, New York City), Granville; the Staso Milling Co. (address, 332 South Michigan Avenue, Chicago, Ill.), Hampton; and the Sheldon Slate Products Co., Middle Granville, which also produces roofing slate. Other roofing-slate producers in New York are The John D. Emack Co. (address, 112 South Sixteenth Street, Philadelphia, Pa.) and the Searles Slate Co.

Granville; Wm. Darius, G. H. Hopkins (address, Whitehall), and the McDonough Slate Co., Middle Granville; and others who operate quarries intermittently and sell their product through dealers or other quarry operators. The chief producers of flagging, walk ways, etc., are The John D. Emack Co., G. H. Hopkins, and the Sheldon Slate Products Co., with addresses as given above.

The Vermont quarries produce roofing slate, mill stock, granules, and slate for walks, etc. The colors are in wide variety and combinations of green and purple and are generally classed as green, unfading green, unfading mottled green and purple, weathering green (sea-green), purple, variegated, and "freak." There are also black and gray varieties. Most of the granules manufactured are green. Much of the roofing slate produced in Vermont is, as in New York, quarried and shaped by owners of small quarries that are worked at irregular intervals. This slate is generally of unusual color and specially sized and is sold through operators of large quarries or through dealers. On account of the variety of colored slates found in the district much of the roofing slate commands a high price. Vermont produced nearly eight times as much roofing slate as New York in 1928 and again ranked next to Pennsylvania in quantity produced. There was a decrease of 6 per cent in the quantity of roofing slate reported sold in Vermont in 1928 as compared with 1927. Slate for roofing and for mill stock used in structural and sanitary work, for electrical purposes, and in billiard-table tops is produced in Vermont, chiefly by the following firms, many small producers being omitted:

Castleton: The John Jones Slate Co.; mill stock.
Castleton and Poultney: The Penrhyn Slate Co. of Vermont (address, Hydeville); roofing , mill stock.
Fair Haven:
  S. Allen's Sons; roofing, mill stock.
  Harvey Bush Slate Co.; roofing.
  Clark-Flanagan (Inc.); roofing, mill stock.
  Durick, Keenan & Co. (Inc.); mill stock.
  Fair Haven Marble & Marbleized Slate Co.; mill stock.
  Hinchey Consolidated Slate Co.; roofing, mill stock.
  Hydeville Slate Works (address, Hydeville); mill stock.
  Pedro Bros. Slate Co. (address, Poultney); roofing.
Pawlet:
  O'Brien Bros. Slate Co. (Inc.) (address, Granville, N. Y.); roofing.
  Ondawa Slate Co. (address, Granville, N. Y.); roofing.
  Owen W. Owens & Sons (Inc.) (address, Granville, N. Y.); roofing.
  Roberts, Jones & Williams (address, Granville, N. Y.); roofing.
  H. G. Williams Slate Co. (address, Granville, N. Y.); roofing.
Pawlet, Poultney, and Rupert: F. C. Sheldon Slate Co. (address, Granville, N. Y.); roofing.
Pawlet and Wells: Norton Bros. (address, Granville, N. Y.); roofing.
Poultney:
  The Auld & Conger Co. (address, 1920 East Seventy-fifth Street, Cleveland, Ohio); Mammouth and Bush quarries; roofing. Quarries not operated in 1928; sales made from stock. Mammouth quarries sold to C. R. Beach.
  Cambrian Slate Co. (address, Granville, N. Y.); roofing.
  Consolidated Slate Corporation of Vermont; roofing.
  El Nido Slate Co.; roofing.
  The John D. Emack Co. (address, 112 South Sixteenth Street, Philadelphia, Pa.); roofing.
  McCarty Slate Co.; roofing.
  Mahar Bros. Slate Co. (Inc.) (address, Fair Haven); roofing, mill stock.
  Montvert Slate Co.; roofing.

Poultney and West Pawlet: Rising & Nelson Slate Co. (address, West Pawlet); roofing.
South Poultney: Owens & Jones (address, Poultney); roofing.
Wells:
  Evergreen Slate Co. (address, Granville, N. Y.); roofing.
  Mettowee Valley Slate Co. (address, Granville, N. Y.); roofing.
  Wm. Morris & Son (address, Granville, N. Y.); roofing.
  Williams Bros. (address, Middle Granville, N. Y.); roofing.
West Pawlet:
  Hughes & Edwards; roofing.
  Jones & Roberts; roofing.
  Patrick Kehoe; roofing.
  Griffith T. Roberts Estate; roofing.

Nearly all of the firms in Vermont that produce mill stock also sell slabs for flagstones, stepping-stones, etc. Vermont produces the greater part of this class of slate. Slate granules and slate flour are produced at Castleton by the Staso Milling Co. (address, 332 South Michigan Avenue, Chicago, Ill.).

Maryland-Pennsylvania.—Production in the Peach Bottom district in Maryland and Pennsylvania was confined to roofing slate and granules in Harford County, Md., and granules in York County, Pa.

Slate for roofing was quarried in Maryland in 1928 at Cardiff, Harford County, by the Peach Bottom Slate Co. of Harford County (address, Delta, Pa.) and the Peerless Slate Co. (address, 213 Martin Building, Pittsburgh, Pa.). The Peerless Slate Co. also produces a small amount of mill stock for structural and sanitary uses. The Staso Milling Co. (address, 332 South Michigan Avenue, Chicago, Ill.) operates a plant for the production of slate granules and flour at Whiteford, Harford County.

The granules from York County, Pa., were produced by The Funkhouser Co. (address, Hagerstown, Md.) near Delta.

Pennsylvania is the largest producer of slate (exclusive of slate granules) in the United States and also produces a greater variety of slate products than any other State, although Maine and Vermont both outrank it in the output of electrical slate. The total value of the slate sold in Pennsylvania by the producers in 1928 was slightly greater than in 1927.

The sales of slate by producers in Pennsylvania, by counties and uses, in 1928 were as follows:

Slate sold by producers in Pennsylvania in 1928, by counties and uses

County	Operators	Roofing slate		Mill stock			
		Squares (100 square feet)	Value	Structural and sanitary [1]		Electrical	
				Square feet	Value	Square feet	Value
Berks, Northampton,[2] and York	3						
Lehigh	9	22,910	$158,121	66,420	$31,335	239,750	$126,456
Northampton	27	233,630	1,875,467	2,689,990	968,431	100,350	85,132
	39	256,540	2,033,588	2,756,410	999,766	340,100	211,588
Total, 1927	40	247,120	1,953,076	2,705,030	923,888	343,050	228,559

[1] Includes slate for grave covers and vaults.
[2] For roofing granules and "flour."

Slate sold by producers in Pennsylvania in 1928, by counties and uses—Contd.

County	Mill stock—Continued				Other [3]	Total value
	Blackboards and bulletin boards		School slates			
	Square feet	Value	Square feet	Value		
Berks, Northampton,[2] and York					$348,728	$348,728
Lehigh	919,870	$194,973	847,870	$22,591		533,476
Northampton	2,793,970	884,479			[4] 90,642	3,904,151
	3,713,840	1,079,452	847,870	22,591	439,370	4,786,355
Total, 1927	3,735,870	1,116,598	780,580	19,998	527,313	4,769,432

[2] For roofing granules and "flour."

[3] In 1927 includes 367,650 square feet of billiard-table material, valued at $120, 762, and 58,480 tons of granules and "flour," valued at $404,385; in 1928 includes 255,890 square feet of billiard-table material, valued at $88,299, and 50,020 tons of granules and "flour," valued at $348,728.

[4] Exclusive of value of roofing granules and "flour," which is included in first entry above.

The principal slate-quarry operators in Pennsylvania and the classes of slate produced by them are as follows:

Berks County: Lenhartsville—Greenwich Manufacturing Co.; slate "flour."

The Lehigh district, which includes Lehigh and Northampton Counties, now produces all of the roofing slate and all of the mill stock sold in the State.

Lehigh County: All the slate companies operating in Lehigh County produce both roofing and mill stock. The quarries are in the vicinity of Emerald, Slatedale, and Slatington. The producing companies in 1928 and their addresses were as follows: J. P. Kern Slate Co., Royal Blue Slate Co., and Shenton Slate Co., Slatedale; American Slate Quarries, Blue Mountain Slate Manufacturing Co., Blue Ridge Quarries (Inc.), Cambridge Slate Co., Manhattan Slate Co., and Slatington Slate Co., Slatington.

Northampton County: The quarry operators in Northampton County and their product in 1928 were as follows:

Bangor:
  Bangor Ideal Slate Mining Co.; roofing.
  Bangor Quarry Co. (address, 1920 East Seventy-fifth Street, Cleveland, Ohio); roofing, mill stock.
  Bangorvein Slate Co.; roofing, mill stock.
  Bangor Washington Slate Co.; roofing.
  Columbia Bangor Slate Co.; roofing.
  North Bangor Slate Co.; roofing, mill stock.
  Old Bangor Slate Co.; roofing.
  Slate Products Co. (Inc.); roofing, mill stock.
Berlinsville: Amalgamated Slate Quarries Co. (address, Easton); Genuine Washington quarries; roofing, mill stock.
Chapman Quarries: Chapman Slate Co. (address, Bethlehem); roofing.
East Bangor: East Bangor Consolidated Slate Co.; roofing, mill stock.
Edelman: The Hard-Vein Slate Co. (address, Easton); roofing.
Pen Argyl:
  Albion Vein Slate Co. (address, Bangor); roofing.
  Belmont Slate Co. (address, Bangor); roofing, mill stock.
  Diamond Slate Co. (Inc.); mill stock.
  Doney Slate Co. (Inc.); roofing, mill stock.
  Jackson-Bangor Slate Co.; roofing, mill stock.
  Keenan Structural Slate Co. (address, Bangor); roofing, mill stock.
  Parsons Bros. Manufacturing Co.; slate "flour."
  Parsons Bros. Slate Co.; roofing, mill stock.
  Stephens-Jackson Co.; roofing, mill stock.
  D. Stoddard & Son (address, Bangor); mill stock.

West Bangor: Bangor Fidelity Slate Co. (address, Bangor); roofing, mill stock.
Windgap:
  Bolger-Heller Slate Co.; roofing, mill stock.
  Colonial Slate Co. (address, Bangor); roofing, mill stock.
  Imperial Slate Blackboard Co.; roofing, mill stock.
  Phoenix Slate Co.; roofing, mill stock.
  M. L. Tinsman & Co. (address, Easton); roofing, mill stock.

Virginia.—Slate was quarried in Virginia in 1928 by the following companies:

Albemarle County:
  Esmont—Blue Ridge Slate Corporation (address, Charlottesville); roofing, granules.
  Monticello—Monticello Slate Co. (address, %Williams-Arvonia Slate Corporation, Richmond); roofing.
Buckingham County:
  Arvonia—
    Arvonia-Buckingham Slate Co. (Inc.) (address, Richmond); roofing.
    Williams Slate Co. (Inc.); roofing.
  Ore Bank—
    Le Sueur-Richmond Slate Corporation; roofing.
    Pierce Slate Co.; roofing.

Other States.—A small amount of slate used for flagging or walk ways was sold from the quarries near Norman, Montgomery County, Ark., in 1928. These quarries are operated by E. C. Bird, of Little Rock; distance of haul to market is said to be the principal reason against the more active development of the quarries.

In June, 1928, the Pacific Mineral Co. (address, Holbrook Building, San Francisco) purchased the Chili Bar slate quarry at Placerville, Eldorado County, Calif., from the Western Slate Products Co. and operated it for slate granules. This quarry was operated in 1927 and early in 1928 by the Commercial Minerals Co.

Slate granules (green) were produced at Fair Mount, Ga., in 1928 by The Funkhouser Co. (address, Hagerstown, Md.). Also near Fair Mount the H. G. Williams Slate Co. (address, Granville, N. Y.) started the development of a slate quarry but marketed no product.

The slate quarries near La Fayette, Sussex County, N. J., which geologically and geographically are in a continuation of the slate districts of Lehigh and Northampton Counties, Pa., were reopened in 1928 and operated by the Lafayette Slate Mining Corporation (address, Port Chester, N. Y.). Some roofing slate was produced but none was put on the market.

The green slate deposit at Tellico Plains, Monroe County, Tenn., was operated in 1928 for granules by The Funkhouser Co. (address, Hagerstown, Md.). Work at this point was abandoned in December, 1928, and the plant was moved to Fair Mount, Ga.

SHIPMENTS

The localization of slate deposits in the most thickly populated part of the United States makes transportation to markets in other areas where cities and towns are growing up a matter of considerable importance to the slate trade. Transportation and freight rates have long been a retarding factor in the slate industry. The total quantity of slate quarried annually is small compared with that of many other mineral products, and no one company has a large output. To facilitate marketing the large quarry companies and joint selling agencies act as distributors for many of the quarries as well as buyers for the slate trade. As a result, many quarry operators have no record of the ultimate destination of their slate. Others refuse to take the trouble to compile the statements which necessarily take time but would seem to be of material value in finding new markets for their slate and in keeping track of fluctuations in their regular markets. Still others object to giving the figures for fear of revealing their market.

The statistics collected by the Bureau of Mines are obtained primarily from the quarrymen rather than from the dealers and jobbers, and the figures showing the distribution of the sales of slate have not been satisfactory. Dealers have, however, cooperated with the Bureau of Mines by furnishing statements of the distribution of their sales for 1928. In New York and Vermont the larger producing companies as well as jobbers and dealers act as distributing agents.

The general trend of shipments of slate products by destination territories, however, is shown in the following table of shipments, the incompleteness of which is largely due to the disinclination of the producers and dealers to supply this information.

Distribution of slate products in 1928, by destinations

Destination	Roofing (squares)	Structural and sanitary (square feet)	Electrical (square feet)	Vaults and covers (square feet)	Blackboards and bulletin boards (square feet)	Billiard-table tops (square feet)	Floors and walks (square feet)	Granules and "flour" (short tons)
Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont	21,250	204,930	131,580	88,290	211,900	1,400	98,460	38,260
Delaware, District of Columbia, Maryland, New Jersey, New York, Pennsylvania, West Virginia	138,390	1,034,680	307,970	310,730	977,400	149,530	492,940	120,560
Illinois, Indiana, Michigan, Ohio	22,290	209,650	103,720	101,550	648,430	38,700	106,060	168,810
Florida, Georgia, North Carolina, South Carolina, Virginia	2,760	51,920	1,490	39,750	158,420	---------	7,260	22,860
Alabama, Kentucky, Louisiana, Mississippi, Tennessee	7,840	17,400	14,220	490	117,200	---------	190	14,510
Arkansas, Iowa, Kansas, Minnesota, Missouri, Nebraska, Oklahoma, Texas, Wisconsin	2,690	59,740	16,020	8,340	380,950	25,370	18,940	11,240
Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, North Dakota, Oregon, South Dakota, Utah, Washington, Wyoming	930	11,860	16,000	4,400	250,700	140	5,930	7,950
Total distribution reported	196,150	1,590,180	591,000	553,550	2,745,000	215,140	729,780	384,190
Total sales	483,280	2,543,470	1,289,060	532,570	3,713,840	293,360	923,330	413,980

SULPHUR AND PYRITES

By Robert H. Ridgway [1]

INTRODUCTION

The recent history of sulphur chronicles the rise of the United States from a position of dependence upon foreign deposits to a place of dominance in world production, so that this country not only supplies its domestic market but furnishes the outside world with exports approximating 700,000 long tons annually. This rise was made possible by the invention of a new and ingenious method of mining, the Frasch hot-water well process, and by the discovery of extensive deposits strategically located near the coast of Louisiana and Texas and near the sources of cheap fuel supply necessary to the unique mining method employed.

During the first few years of the century, the sulphur-consuming industries of the United States were supplied largely with imported brimstone and pyrites, domestic pyrites being of minor importance and domestic sulphur almost negligible. The average annual consumption of sulphur in the first four years of the century amounted to 459,000 long tons. In 1903 the production of sulphur in Louisiana by the Frasch process began on a large scale, and the United States soon became an important factor in the world market.

The 13-year period 1904 to 1916 was characterized by a steady increase in the domestic production of pyrites, by an increase in the imports of pyrites, and by a sudden increase in the production of domestic brimstone. This increase in domestic production of sulphur was accompanied by decreased imports and increased exports of sulphur resulting in a net annual outflow of 6,000 long tons. If this net annual outflow is deducted and proper allowance is made for a total of more than a million tons of brimstone accumulated in stocks during the period, the total sulphur made available in brimstone and pyrites indicates an average annual consumption of about 794,000 long tons of sulphur, exclusive of any utilization of by-product smelter fumes. About 517,000 tons of this total sulphur consumed was derived from pyrites.

The entry of the United States into the World War marks an important milestone in the expansion of the American sulphur industry. The need for transportation facilities for essential traffic between the United States and Europe resulted in drastic curtailment of bottoms engaged in other traffic. Imports of pyrites from Spain and Portugal at first could not be increased to meet the growing demand. Later, in 1918, imports of pyrites fell off in amount. Therefore manufacturers turned more and more to domestic brimstone. At the close of the war many of the industries continued to use sulphur rather than change their plants back to handle pyrites. During the period 1917 to 1928, inclusive, the average annual production of brimstone in the United States amounted to 1,608,000 long tons, compared with an annual average of 365,000 tons for the period 1904 to 1916, inclusive. Imports of foreign sulphur during the period were negligible. Exports during the period averaged annually about 449,000 long tons, increasing from 152,736 tons in 1917 to 789,274 tons in 1927, but decreasing 13 per cent in 1928 to 685,051 tons. Domestic pyrites production decreased from an average annual of 296,000 long tons (1904–1916) to an average annual of 257,000 tons (1917–1928), whereas pyrites imports dropped from an average annual of nearly 800,000 long tons for the earlier period to an average of 379,000 tons for the later. Domestic consumption (exclusive of any utilization of by-product smelter fumes) of sulphur as brimstone and pyrites increased during the same time from an average of 794,000 tons to an average of about 1,374,000 tons.

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[1] Figures on domestic production compiled by H. M. Meyer, and those on imports and exports compiled from records of the Bureau of Foreign and Domestic Commerce by J. A. Dorsey, both of the Bureau of Mines.

The foregoing brief résumé will provide a setting for the situation in 1928, shown in detail on the following pages. This situation may be summarized as follows: Compared with 1927, shipments of domestic sulphur increased in 1928 less than 1 per cent to a record figure of 2,082,924 long tons, whereas production decreased 6 per cent; imports of "sulphur and sulphur ore" amounted to less than 5,000 long tons, whereas exports of crude sulphur decreased from 789,274 long tons to 685,051 tons, or 13 per cent, and were equivalent to about one-third of the domestic shipments. There was a substantial increase in the consumption of sulphur in the United States, notably in the increased manufacture of sulphuric acid, due in turn to increased production of fertilizers. In 1928 production of pyrites in the United States amounted to 182,049 long tons, a decrease of 16 per cent from 1927, whereas imports amounted to 457,123 long tons, an increase of 82 per cent over 1927.

SULPHUR

DOMESTIC PRODUCTION

Sulphur production of the United States in 1928 was 1,981,873 long tons, compared with 2,111,618 tons in 1927, a decrease of 6 per cent. The shipments from the mines in 1928, however, were record breaking and amounted to 2,082,924 long tons, valued at approximately $37,500,000, compared with 2,072,109 tons, valued at approximately $38,300,000, in 1927.

The stocks on hand at the mines decreased about 100,000 long tons in 1928, and slightly exceeded 2,000,000 tons at the end of the year.

The average price for sulphur as quoted by the trade journals was $18 a long ton f. o. b. mines throughout the year. Open prices were $1 a ton higher, and prices for sulphur exported were given as $22 a long ton f. a. s. Atlantic ports.

The following table shows the progress of American sulphur production from 1909 to 1928.

Sulphur produced and shipped in the United States, 1909–1928

Year	Produced (long tons)	Shipped		Year	Produced (long tons)	Shipped	
		Long tons	Approximate value			Long tons	Approximate value
1909	273, 983	258, 203	$4, 782, 000	1919	1, 190, 575	678, 257	$10, 252, 000
1910	247, 060	250, 919	4, 522, 000	1920	1, 255, 249	1, 517, 625	30, 000, 000
1911	205, 066	253, 795	4. 573, 000	1921	1, 879, 150	954, 344	17, 000, 000
1912	787, 735	305, 390	5, 289, 000	1922	1, 830, 942	1, 343, 624	22, 000, 000
1913	491, 080	319, 333	5, 617, 000	1923	2, 036, 097	1, 618, 841	26, 000, 000
1914	417, 690	341, 985	6, 214, 000	1924	1, 220, 561	1, 537, 345	25, 000, 000
1915	520, 582	293, 803	4, 959, 000	1925	1, 409, 262	1, 858, 003	29, 000, 000
1916	649, 683	766, 835	12, 246, 000	1926	1, 890, 027	2, 072, 657	37, 300, 000
1917	1, 134, 412	1, 120, 378	23, 987, 000	1927	2, 111, 618	2, 072, 109	38, 300, 000
1918	1, 353, 525	1, 266, 709	27, 868, 000	1928	1, 981, 873	2, 082, 924	37, 500, 000

Texas contributed 99.88 per cent of the total 1928 production and Texas and Louisiana together accounted for 99.87 per cent of the total shipments. The Louisiana shipments were from the remaining stocks of the Union Sulphur Co., which suspended mining operations in 1924. Increased shipments of sulphur were reported from Nevada and Utah.

Two new properties contributed to the sulphur production of Texas in 1928, those of the Union Sulphur Co. at Wharton, Wharton County, and the Duval-Texas Sulphur Co. at Benavides, Duval County. The first unit of the new plant of the Duval-Texas Sulphur Co. started operations November 1, 1928,[2] and at the end of the year production amounted to approximately 240 [3] tons of sulphur a day from a deposit which is reported to cover the greater part of 2,000 acres. The company plans to begin exporting through the port of Corpus Christi as soon as the surface supply is sufficient to justify construction of a warehouse and other port facilities. The port is only 65 miles from the mine. It was reported [4] at the end of the year that the Union Sulphur Co. was producing 250 tons a day (all from one well) at its new plant near Wharton. Other wells are expected to be placed in operation as rapidly as they can be put down and equipped, and the production of this property should be greatly expanded within a few months.

The Texas Gulf Sulphur Co. is making extensive preparations for production of sulphur at Newgulf, Wharton County, Tex., where it has developed a potential tonnage said to be the largest so far discovered on the Gulf coast.[5] The company has purchased a tract of land and is laying out a new town site, building spur tracks, and installing machinery for production. Production is expected to start early in 1929, only two years after the first disclosure, by drilling, that sulphur might be developed in quantity.

These new installations, coupled with activities in the field of geophysical prospecting, presage extensive development in sulphur production. Previous to 1924 only 39 domes had been found in the

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[2] Engineering and Mining Journal, vol. 127, Apr. 6, 1929, p. 572.
[3] Engineering and Mining Journal, vol. 126, Dec. 15, 1928, p. 956.
[4] Engineering and Mining Journal, vol. 126, Dec. 8, 1928, p. 916.
[5] Engineering and Mining Journal, vol. 125, Jan. 14, 1928, p. 66.

Gulf coast district, but since then more than 60 [6] have been located by geophysical methods incident to the search for oil. Twenty-two of these have proved to be salt domes; the rest are such new discoveries that little if any drilling has been done to prove them. Of the total of 64 prospective domes discovered since 1924, 30 were located in 1928. Not all of these domes will contain commercial quantities of sulphur but some will, and, should the same ratio of sulphur-bearing domes to total domes discovered hold true in the future as in the past, an immense reserve of sulphur would be shown.

IMPORTS AND EXPORTS

The imports of sulphur into the United States reached a peak in 1903, when nearly 189,000 long tons was imported, but with the rapid increase in American production the imports have declined and since 1917 have been of little consequence. In 1928, 4,787 long tons of "sulphur and sulphur ore," valued at $21,320, was imported.

The first recorded export of American sulphur was a cargo of 3,000 tons from Louisiana in 1904. Since then there has been a steady increase until now the annual export is more than two hundred times that figure. Exports of crude American sulphur in 1928 amounted to 685,051 long tons, valued at $14,345,075, compared with 789,274 tons, valued at $16,254,227, in 1927, a decrease of 13 per cent in quantity. The exports in 1927 were the highest ever recorded, and those of 1928 ranked second. The consumption of sulphur by foreign industry was about the same in 1928 as in 1927. The decline in American exports in 1928 was caused in part by the consumption of stocks accumulated previously by foreign users.

The following table shows the crude sulphur imported into and exported from the United States from 1909 to 1928.

Crude sulphur imported into and exported from the United States, 1909–1928

Year	Imports for consumption		Exports		Year	Imports for consumption		Exports	
	Long tons	Value	Long tons	Value		Long tons	Value	Long tons	Value
1909	28,800	$492,962	37,142	$736,928	1919	77	$1,997	224,712	$6,325,552
1910	28,656	496,073	30,742	552,941	1920	44	1,722	477,450	8,994,350
1911	24,200	434,796	28,103	545,420	1921	4	226	285,762	4,524,768
1912	26,885	494,778	57,736	1,076,414	1922	[1] 167	6,453	485,664	7,095,628
1913	15,122	286,209	89,221	1,599,761	1923	[2] 465	21,535	472,525	7,105,260
1914	23,610	398,984	98,163	1,807,324	1924	[2] 1,005	40,293	482,114	7,792,854
1915	24,647	405,990	37,312	724,679	1925	[2] 100	4,411	629,401	11,000,235
1916	21,289	358,416	128,755	2,505,857	1926	[2] 48	1,052	576,966	10,918,394
1917	973	20,176	152,736	3,500,819	1927	[2] 3,384	34,487	789,274	16,254,227
1918	55	1,692	131,092	3,626,638	1928	[2] 4,787	21,320	685,051	14,345,075

[1] Composed of 130 tons of "crude sulphur," imported Jan. 1 to Sept. 21, and 37 tons of "sulphur and sulphur ore," imported Sept. 22 to Dec. 31.

[2] Classified as "sulphur and sulphur ore."

In addition to the brimstone or crude sulphur the United States exports refined products. Exports of refined, sublimed, and flowers of sulphur increased from 31,419,221 pounds, valued at $544,373, in 1927 to 44,536,508 pounds, valued at $706,766, in 1928. The average value in 1928 was 1.59 cents a pound, or $36 a long ton.

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[6] Oil and Gas Journal, vol. 27, No. 25, Nov. 8, 1928, p. 35.

Canada was the largest importer of American crude sulphur in 1928, taking 159,664 long tons (23.3 per cent of the total exported); Germany was second with 125,659 tons (18.3 per cent); France was third with 109,348 tons (16 per cent); and Australia was fourth with 85,500 tons (12.5 per cent). These four countries received about 70 per cent of the total exports of American brimstone.

Germany was the best customer for American refined sulphur in 1928, taking 18,025,199 pounds, or 40 per cent of the total exported. Canada was second with 7,562,023 pounds, or 17 per cent, and was followed by Belgium, Australia, Brazil, and Uruguay.

The following table of exports for 1927 and 1928 indicates a decreased demand from some of the larger consumers of American crude sulphur. In 1928 crude sulphur exports to Germany decreased nearly 50,000 tons from those of 1927. This apparent decline in exports does not necessarily reflect the condition of German sulphur-consuming industries, because German ports are often utilized in the trade as transfer points for much of the sulphur destined for other European countries.[7] Cargoes of sulphur consigned to German ports may be sold en route and redirected by radio, or they may arrive in Germany and be transferred in small lots to a number of smaller vessels capable of movement into ports inaccessible to the original vessel. The exports of sulphur from Germany in 1928 were equivalent to 63 per cent of the imports. Countries importing sulphur from Germany in 1928 were Sweden (21,036 metric tons), Finland (22,165 tons), Great Britain (2,594 tons), Russia (2,020 tons), British India (1,874 tons), Portugal (967 tons), and Danzig (934 tons). Australia, France, and Canada all imported smaller amounts of American brimstone in 1928 than in 1927, whereas a substantial increase was noted for the United Kingdom and smaller increases for Newfoundland and Labrador, Mexico, Brazil, and Argentina.

Sulphur exported from the United States, 1927 and 1928, by destinations

Destination	Sulphur or brimstone		Refined, sublimed, and flowers of	
	Long tons	Value	Pounds	Value
1927				
North America:				
Canada	165,141	$2,987,687	8,038,529	$139,990
Central America	94	2,683	433,399	9,861
Mexico	12,463	269,604	1,778,491	37,659
Newfoundland and Labrador	4,152	76,686	25,208	562
West Indies and Bermuda	4,001	56,089	210,763	5,945
	185,851	3,392,749	10,486,390	194,017
South America:				
Argentina	6,480	138,180	------------	------------
Brazil	3,045	67,215	2,762,374	55,875
Colombia	------------	------------	143,690	4,558
Uruguay	------------	------------	1,249,159	22,025
Other	2,310	49,074	165,547	3,067
	11,835	254,469	4,320,770	85,525

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[7] World Trade Notes, vol. 3, No. 15, Apr. 15. 1929, p. 1.

Sulphur exported from the United States, 1927 and 1928, by destinations—Contd.

Destination	Sulphur or brimstone		Refined, sublimed, and flowers of	
	Long tons	Value	Pounds	Value
1927				
Europe:				
Belgium	9,119	$203,343	1,014,310	$17,337
Finland	2,620	52,217		
France	126,664	2,790,698	414,850	5,961
Germany	175,511	3,790,977	8,355,410	117,833
Netherlands	50,775	1,104,779		
Portugal	5,200	109,200		
Spain	12,069	262,509	540	31
United Kingdom	36,450	745,875	2,793,435	48,155
Other	3,696	75,254	323,300	5,816
	422,104	9,134,852	12,901,845	195,133
Asia	112	2,700	564,431	9,568
Africa:				
Algeria and Tunisia	8,496	180,864		
Union of South Africa	20,307	418,337	217,048	3,853
	28,803	599,201	217,048	3,853
Oceania:				
Australia	114,593	2,337,020	2,563,157	46,076
New Zealand	25,976	533,236	365,580	10,201
	140,569	2,870,256	2,928,737	56,277
	789,274	16,254,227	31,419,221	544,373
1928				
North America:				
Canada	159,664	2,897,730	7,562,023	140,604
Central America	126	3,690	352,299	8,887
Mexico	14,829	317,192	1,479,211	31,305
Newfoundland and Labrador	7,751	148,448	44,685	971
West Indies and Bermuda	3,022	42,907	171,124	7,439
	185,392	3,409,967	9,609,342	189,206
South America:				
Argentina	8,680	182,280	1,200	39
Brazil	5,359	122,759	2,374,781	45,424
Colombia			120,754	3,906
Uruguay			2,239,980	31,164
Other	161	4,131	289,492	5,311
	14,200	309,170	5,026,207	85,844
Europe:				
Belgium	10,970	243,791	2,662,213	39,067
Finland	1	37		
France	109,348	2,408,898	130,900	2,006
Germany	125,659	2,847,969	18,025,199	245,157
Netherlands	48,928	1,103,985	922,112	14,139
Spain	11,098	243,677		
United Kingdom	44,098	924,155	1,958,846	28,522
Other	4,750	95,000	2,351,675	32,882
	354,852	7,867,512	26,050,945	361,773
Asia	5,000	100,000	599,941	9,687
Africa:				
Algeria and Tunisia	4,428	98,213		
Mozambique	1,800	41,400	25,000	371
Union of South Africa	11,078	243,716	392,928	6,382
	17,306	383,329	417,928	6,753
Oceania:				
Australia	85,500	1,799,641	2,422,835	43,789
New Zealand	22,801	475,456	409,310	9,714
	108,301	2,275,097	2,832,145	53,503
	685,051	14,345,075	44,536,508	706,766

CONSUMPTION

The use of sulphur in various domestic industries has been estimated by Chemical and Metallurgical Engineering for 1927 and 1928, as follows:

Sulphur consumed in the United States, 1927 and 1928, by uses, in long tons

Use	1927	1928
Heavy chemicals	490,000	520,000
Fertilizer and insecticides	300,000	345,000
Pulp and paper	260,000	250,000
Explosives	65,000	60,000
Dyes and coal tar products	40,000	42,000
Rubber	35,000	40,000
Electrochemicals	20,000	21,000
Fine chemicals	13,000	14,000
Paint and varnish	5,000	5,000
Food products	3,000	5,000
Petroleum products	1,000	1,000
Miscellaneous	118,000	123,000
	1,350,000	1,426,000

Fertilizers and heavy chemicals consumed increased amounts of sulphur, whereas pulp and paper consumed less, as the paper industry was operating at only about 80 per cent of capacity. The use of sulphur in the rubber industry increased to a smaller extent, whereas that in explosives decreased. The other consuming industries required about the same amounts in 1928 that they did in 1927.

It was reported[8] that sulphur dusting had been used successfully in preventing rust in the grain fields of Canada.

The chief use of sulphur is in the manufacture of sulphuric acid, an industry that in 1928 enjoyed its best year since the war. The following table shows the estimated distribution of the consumption of sulphuric acid by industries for 1927 and 1928, as given by Chemical and Metallurgical Engineering.

Sulphuric acid (expressed as 50° B.) consumed in the United States, 1927 and 1928, by industries, in short tons

Industry	1927	1928
Fertilizer	2,135,000	2,300,000
Petroleum refining	1,250,000	1,350,000
Chemicals	725,000	745,000
Coal products	732,000	740,000
Iron and steel	685,000	695,000
Other metallurgical	600,000	600,000
Paints and pigments	210,000	210,000
Explosives	183,000	170,000
Textiles	135,000	130,000
Miscellaneous	280,000	285,000
	6,935,000	7,225,000

Figures for the production of sulphuric acid as a by-product at smelting plants in 1927 and 1928 follow. The table gives the output at both copper and zinc plants; this constitutes practically all of the by-product acid produced in the United States.

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[8] World Trade Notes, vol. 2, No. 50, Dec. 10, 1928, p. 2.

By-product sulphuric acid (expressed as 60° B.) produced at copper and zinc plants in the United States, 1927 and 1928, in short tons

	1927	1928
Copper plants	452, 855	581, 731
Zinc plants	588, 544	558, 537
	1, 041, 399	1, 140, 268

FOREIGN PRODUCTION

Sicily, the chief source of sulphur besides the United States, is reported to have produced 215,280 metric tons (9 per cent of the world's total) as compared with 231,440 tons in 1927. The production of continental Italy, chiefly Romagna, is given as 80,827 metric tons, making the total estimated production of Italy 296,107 tons, a slight decrease from that of 1927.

The shipments of sulphur from Sicily decreased from 228,816 metric tons in the fiscal year ended July 31, 1927, to 211,920 tons in the fiscal year ended July 31, 1928, a decline of more than 7 per cent. A table showing the quantity and destination of the consignments follows.

Sulphur shipped from Sicily during the fiscal years ended July 31, 1927 and 1928, by destinations, in metric tons [1]

Destination	1927			1928		
	Raw	Refined	Total	Raw	Refined	Total
To foreign countries:						
Africa—Algeria, Egypt, Tunisia	1, 480	1, 710	3, 190	3, 185	2, 020	5, 205
America, Central and Southern	963	3, 925	4, 888	1, 801	3, 809	5, 610
Austria	11, 981	359	12, 340	11, 580	187	11, 767
Belgium	1, 400	424	1, 824	508	327	835
England and Malta	54, 310	2, 031	56, 341	41, 524	2, 165	43, 689
Finland	2, 300	5	2, 305	3, 302		3, 302
France	23, 423	2, 290	25, 713	32, 810	2, 228	35, 038
Germany	2, 982	2, 409	5, 391	1, 910	1, 914	3, 824
Greece		15, 583	15, 583		14, 974	14, 974
Hungary	750	305	1, 055	365	84	449
India, British	9, 664	3, 619	13, 283	11, 640	3, 558	15, 198
Indies, Netherland East	5, 587	7, 254	12, 841	5, 093	10, 836	15, 929
Norway	1, 626	421	2, 047	935	298	1, 233
Portugal		2, 319	2, 319	4, 697	1, 200	5, 897
Rumania	1, 254	770	2, 024	1, 054	286	1, 340
Russia	3, 381	872	4, 253	9, 052	4, 497	13, 549
Sweden	10, 469	210	10, 679	3, 150	425	3, 575
Turkey		3, 222	3, 222		3, 211	3, 211
Yugoslavia	540	1, 182	1, 722	220	263	483
Other countries	644	4, 628	5, 272	1, 831	5, 547	7, 378
	132, 854	53, 538	186, 392	134, 657	57, 829	192, 486
To Sicily and continental Italy	21, 744	20, 680	42, 424	9, 283	10, 151	19, 434
	54, 598	74, 218	228, 816	143, 940	67, 980	211, 920

[1] La Miniera Italiana, January, 1929.

The present tendency of the Sicilian sulphur industry is toward integration. There are [9] three large, well-organized mines in Sicily which furnish three-fourths of the total Sicilian output of sulphur; the remainder of the output is furnished by 384 small companies with an average annual production of 167 tons each. Improved organization of the industry is resulting in reduced production costs and improved quality. Recent electrification and mechanization of the mines have also been instrumental in effecting economies. However, in recent years the sulphur industry has been hard hit by the revalorization of the lira. Wage reductions and lower transportation costs have not been sufficient to offset this loss. The operation of the Beluzzo law may effect further economies in the cost of sulphur production by eliminating the high royalties which have been paid to the owners of the land. This law [10] practically dispossesses the landowners of their subsoil rights, making such rights a part of the State demesne. Existing concessions are allowed to stand until the expiration of contracts, and therefore the effect of the new legislation will not be felt for a year or two. In the meantime, however, the royalty percentage payable on existing contracts has been in every case reduced by one-third. Although 1928 showed decreased production and shipments, considerable progress has been made in the organization of the industry, making the outlook for the future more optimistic.

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[9] World Trade Notes, vol. 2, No. 16, Apr. 16, 1928, p. 1.

Japan produced 66,619 metric tons of sulphur in 1928; most of the Japanese sulphur is consumed at home, but in 1928 about 5,000 tons was exported, chiefly to China and Hong Kong. Spain probably produced about 15,000 metric tons of sulphur in 1928. The production of Chile probably exceeded 10,000 metric tons, chiefly for its own market; however, an effort is being made to market Chilean sulphur in Argentina. Enormous deposits have been reported [11] newly discovered at Putana Volcano in the Province of Antofagasta, Chile, near the frontier of Bolivia. (The geographical location is as follows: 22° 30′ S. and 67° 53′ W., the altitude being over 5,000 meters above sea level.) Native sulphur is also mined in Greece, where about 2,000 tons is obtained annually; practically all of this comes from the volcanic island of Melos. The sulphur production of China is estimated at 5,600 metric tons per year. Several other countries produce smaller amounts of sulphur. The world production in 1928 is estimated as 2,413,000 metric tons.

PYRITES

DOMESTIC PRODUCTION

The production of pyrites in the United States in 1928 was 182,049 long tons, valued at $605,459, compared with 215,786 tons, valued at $804,006, in 1927. The 1928 output was a decrease of 16 per cent in quantity from 1927 but was larger than that in any other year since 1920; the total value in 1928 was less than in any year since 1899. California and Virginia produced the entire tonnage recorded for 1927 and 1928. The quantity sold or used by producing companies also showed a large decrease—from 206,724 tons in 1927 to 179,484 tons in 1928, or 13 per cent. The larger part of the pyrites mined in 1928 was used by the producers themselves. The output of pyrites in the United States during the last 20 years is shown in the following table.

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[10] Humes, Elizabeth, Trade Commissioner, Rome, Italy, The Sicilian Sulphur Industry: Bur. of For. and Dom. Commerce Spec. Cir. 253, Chem. Div., Apr. 5, 1929.

[11] Engineering and Mining Journal, vol. 127, Mar. 30, 1929, p. 531.

Pyrites produced in the United States, 1909–1928

Year	Long tons	Value	Year	Long tons	Value
1909	247, 070	$1, 028, 157	1919	420, 647	$2, 558, 172
1910	241, 612	977, 978	1920	310, 777	1, 596, 961
1911	301, 458	1, 164, 871	1921	157, 118	711, 432
1912	350, 928	1, 334, 259	1922	169, 043	671, 241
1913	341, 338	1, 286, 084	1923	181, 628	661, 000
1914	336, 662	1, 283, 346	1924	160, 096	645, 262
1915	394, 124	1, 674, 933	1925	170, 081	650, 448
1916	439, 132	2, 038, 002	1926	166, 559	616, 668
1917	482, 662	2, 593, 035	1927	215, 786	804, 006
1918	464, 494	2, 644, 515	1928	182, 049	605, 459

IMPORTS AND EXPORTS

The imports of pyrites in 1928 amounted to 457,123 long tons, valued at $1,135,463, an increase of 82 per cent in quantity and 75 per cent in value from the 250,794 tons, valued at $647,512, imported in 1927; they were larger than in any year since 1918. Spain furnished 393,840 long tons in 1928, or 86 per cent of the total imports, and Canada 56,956 tons, or 12 per cent.

For several years prior to 1918 the annual imports of pyrites averaged nearly 1,000,000 tons; in 1918, however, due to scarcity of ocean transportation, there was a 50 per cent curtailment. Coincidently there was a marked increase in the domestic production of sulphur, substituted for pyrites in many of its uses, and as a result imports of pyrites decreased still more; the 1927 imports amounted to only 26 per cent of the 1917 imports. The increase in imports in 1928 was probably due in part to the increased demand for sulphuric acid in the fertilizer industry.

The rise in imports from 1909 to 1916 and their subsequent fall are shown by the following table.

Sulphur ore as pyrites, containing more than 25 per cent of sulphur, imported for consumption in the United States, 1909–1928

Year	Long tons	Value	Year	Long tons	Value
1909	688, 843	$2, 428, 580	1919	388, 973	$2, 176, 565
1910	803, 551	2, 748, 647	1920	332, 606	1, 660, 832
1911	1, 006, 310	3, 788, 803	1921	216, 229	818, 852
1912	970, 785	3, 841, 683	1922	279, 445	1, 199, 076
1913	850, 592	3, 611, 137	1923	263, 695	1, 254, 389
1914	1, 026, 617	4, 797, 326	1924	246, 737	598, 544
1915	964, 634	4. 817, 977	1925	276, 385	773, 925
1916	1, 244, 662	6, 728, 318	1926	366, 151	856, 981
1917	967, 340	5, 981, 457	1927	250, 794	647, 512
1918	496, 792	2, 741, 676	1928	457, 123	1, 135, 463

Exports of "pyrites or other sulphur ore" have not been separately shown since 1922, when they amounted to 323 long tons, valued at $4,325.

WORLD PRODUCTION

The following table shows the world production of pyrites, together with the quantity of pure sulphur it is supposed to replace in the market. For the most part the figures are taken from the official sources of the countries concerned, supplemented by information taken from the publications of the Imperial Mineral Resources Bureau.

World production of iron pyrites (including cupreous pyrite), 1924–1928, in metric tons

[Compiled under supervision of L. M. Jones, of the Bureau of Mines]

Country	1924	1925	1926	1927	1928
Algeria:					
Gross weight	17,870	12,566	11,505	12,918	13,825
Sulphur content	8,400	5,950	5,386	6,071	6,498
Austria:					
Gross weight	28,046	25,072	22,293	19,328	10,000
Sulphur content	6,031	5,712	5,137	3,153	2,000
Canada:					
Gross weight	21,366	14,157	16,189	43,956	59,655
Sulphur content	8,838	6,883	8,142	(1)	(1)
Cyprus: [2]					
Gross weight	141,050	176,036	152,776	211,462	243,913
Sulphur content	70,525	88,018	76,387	105,731	(1)
Czechoslovakia:					
Gross weight	15,935	21,594	22,512	23,300	23,626
Sulphur content	(1)	8,854	9,005	9,203	9,332
Finland:					
Gross weight	1,064	(1)	(1)	(1)	(1)
Sulphur content	(1)	(1)	(1)	(1)	(1)
France:					
Gross weight	194,157	212,559	192,340	203,700	202,084
Sulphur content	[3] 84,032	[3] 90,187	90,748	(1)	(1)
Germany:					
Gross weight	159,623	223,293	237,870	350,430	(1)
Sulphur content	48,144	82,041	98,939	149,531	(1)
Great Britain:					
Gross weight	5,658	5,373	4,307	4,968	4,370
Sulphur content	(1)	(1)	(1)	(1)	(1)
Greece:					
Gross weight	76,262	65,000	81,000	100,050	94,270
Sulphur content	35,401	31,525	39,577	48,884	(1)
Hungary:					
Gross weight	----------	138	176	(1)	(1)
Sulphur content	----------	(1)	(1)	(1)	(1)
Italy:					
Gross weight	515,781	533,737	594,479	625,338	558,390
Sulphur content	237,398	243,922	273,248	286,227	256,683
Japan:					
Gross weight	220,456	312,627	417,513	506,089	(1)
Sulphur content	(1)	(1)	(1)	(1)	(1)
Norway:					
Gross weight	403,411	624,375	634,836	617,044	(1)
Sulphur content	173,389	266,903	272,330	266,855	(1)
Poland:					
Gross weight	7,843	11,217	18,850	24,596	10,668
Sulphur content	(1)	(1)	(1)	(1)	(1)
Portugal:					
Gross weight	(1)	217,296	210,487	(1)	(1)
Sulphur content	(1)	(1)	(1)	(1)	(1)
Rumania:					
Gross weight	32,657	26,983	42,039	25,514	23,715
Sulphur content	(1)	(1)	(1)	(1)	(1)
Russia: [4]					
Gross weight	27,184	54,996	105,244	167,499	(1)
Sulphur content	(1)	16,800	(1)	(1)	(1)
Spain:					
Gross weight	2,212,365	3,359,240	3,654,789	3,610,694	3,618,691
Sulphur content	1,027,600	1,539,846	1,658,391	1,609,776	(1)
Sweden:					
Gross weight	66,353	69,873	69,759	69,239	(1)
Sulphur content	25,616	26,695	27,073	32,126	(1)
Union of South Africa:					
Gross weight	2,349	2,512	2,448	2,254	3,754
Sulphur content	(1)	(1)	(1)	(1)	(1)
United States:					
Gross weight	162,666	172,811	169,232	219,249	184,971
Sulphur content	(1)	(1)	(1)	(1)	(1)
Yugoslavia:					
Gross weight	[5] 26,306	38,988	53,376	57,003	64,273
Sulphur content	(1)	(1)	(1)	(1)	(1)

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[1] Data not available.

[2] Exports.

[3] Exclusive of sulphur content of following quantities of iron pyrite for which figures of content are not available: 1924, 9,452 tons; 1925, 13,516 tons.

[4] Year ended Sept. 30.

[5] Serbia only.

FELDSPAR

By Oliver Bowles and Jefferson Middleton

GENERAL CONDITIONS

Excessive production capacity and keen competition are reflected in conditions that prevailed at the end of 1928 in the feldspar industry. Although the output of crude feldspar in 1928—210,811 long tons—was the highest on record, the average value per ton dropped for the second successive year. It was $6.73 in 1928, practically the same as the value in 1921, was 31 cents lower than that in 1927, and was 92 cents lower than that in 1926, which is the year of highest average recorded value. The average values of crude feldspar in the United States in 1928, as reported by individual producers, ranged from $3 to $12.31. For New England the range was from $5.13 to $12.31; for Maryland, New York, Pennsylvania, and Virginia, from $3 to $9.74; for North Carolina, from $4 to $7.42; and for Arizona, California, Colorado, and South Dakota, from $3 to $9.77. The output of crude feldspar in 1928 was 4 per cent greater in quantity than that in 1927 and 0.4 per cent greater than that in 1926. The total value of the crude feldspar sold in 1928 decreased 0.4 per cent compared with 1927 and 12 per cent compared with 1926. The output of ground feldspar was also the highest on record, reaching 227,657 short tons or 2 per cent more than in 1927 and 1 per cent more than in 1926. The total value of the ground feldspar sold in 1928 decreased 3 per cent compared with 1927 and 8 per cent compared with 1926.

A notable feature of the industry during 1928 was the tendency toward consolidation of companies into groups under single control. The largest of these consolidations, that headed by H. P. Margerum, president of the Golding Sons Co., brings under one control the Golding Sons Co. of Trenton, N. J., the Erwin Feldspar Co. (Inc.) of Erwin, Tenn., and the Consolidated Feldspar Corporation which according to report comprises the following units: The Maine Feldspar Co. of Brunswick, Me., with a mill at Topsham and one at Auburn, Me.; the Bedford Mining Co. (Inc.), with mines and mill at Bedford, N. Y.; the Dominion Feldspar Corporation and the New York Feldspar Corporation, both of which are at Rochester, N. Y.; and the Isco-Bautz Co. (Inc.) of Murphysboro, Ill. The Consolidated Feldspar Corporation has also purchased the feldspar property in Arizona near Kingman, and has under construction a new mill at Keystone, S. Dak. Possibly other companies may be included later. The purpose of the consolidation is to form a well-rounded feldspar company having ample supplies of raw material and adequate milling facilities in the chief feldspar districts.

It is reported that another consolidation—the United Feldspar Corporation, headed by Charles H. Peddrick, jr., of New York—will include the Tennessee Mineral Products Co. of Spruce Pine, N. C.; the Oxford Mining & Milling Co. of Portland, Me.; and the United States Feldspar Corporation of Cranberry Creek, N. Y. The Roessler & Hasslacher Chemical Co. of New York will be sole selling agents.

A probable important effect of more centralized control in the industry will be the preparation of a series of well-graded, uniform products, greatly desired by the pottery industries.

VARIETIES OF FELDSPAR

Feldspar, or " spar " as it is commonly called by miners, is a general name for a group of rock-forming minerals that vary somewhat in composition. The most important varieties from a commercial standpoint are orthoclase ($KAlSi_3O_8$), or potash feldspar, and microcline which has the same composition as orthoclase and differs only in crystal form; these varieties constitute the great bulk of the feldspar that finds commercial use. Albite ($NaAlSi_3O_8$), or soda feldspar, anorthite ($CaAl_2Si_2O_8$), or lime feldspar, and mixtures of these are used to some extent. Celsian or barium feldspar is infrequently found in very small quantities.

OCCURRENCE

Feldspar forms a considerable part of such common and widespread igneous rocks as granites, in which it occurs in grains varying in size from that of a pinhead to one-half inch or more in diameter. Feldspar occurring in this way can not be separated profitably from quartz, mica, hornblende, and other associated minerals; therefore the ordinary granites and related rocks are not to be regarded as sources of commercial feldspar.

The feldspar of commerce is obtained from pegmatite dikes which have in general the composition of granite; these dikes consist largely of feldspar and quartz but differ from granites in that they are of very coarse, irregular texture. Many single crystals have a diameter of 1 foot or even several feet. Pegmatites are generally regarded as representing the final stage of consolidation of granite masses. The molten material, consisting largely of the constituents of feldspar and quartz, contained also water vapor and various volatile elements and gases, such as fluorine, boron, chlorine, phosphorus, and sulphur. These so-called mineralizing agents tended to maintain a condition of fluidity in the mass and thus promoted crystallization, giving the pegmatites their characteristic coarse-grained texture. The gases and vapors combined in various ways and crystallized out, forming small quantities of such characteristic pegmatite minerals as muscovite, biotite, tourmaline, garnet, and beryl. The fluid mass, from which pegmatites have been formed, was forced by the great pressure into fractures or lines of weakness in the rocks already solidified. Thus veins were formed passing irregularly throughout the granitic mass and in many places extending to crevices that penetrate beyond the granite into other kinds of rock.

LACK OF UNIFORMITY

Commercial spar may consist of different varieties of feldspar of diverse chemical composition. As stated, feldspar is a term applied to a group of minerals, all of which are aluminum silicates containing potassium, sodium, or calcium in varying proportions. Not only do individual deposits differ greatly in the type of spar they contain but there may be marked variations in the same deposit. Furthermore, quartz is nearly always associated with the feldspar and the proportion of quartz present may vary from almost zero to as high as 35 per cent. Potters usually demand a uniform product, the composition of which is constant from day to day. In view of the variations mentioned above this requirement is somewhat difficult to fulfill, and the best thought of the industry is being directed toward means of overcoming these difficulties.

Some pegmatite dikes represent a single fluid or molten intrusion, whereas in others a banded structure is in evidence, the various bands representing succeeding periods of intrusion and solidification. The contact of the pegmatite dike with the inclosing rock walls may be indistinct, as though the dike had been intruded before the walls were completely solidified or possibly because the intruded material had melted and blended with the wall rock; on the other hand, the contact may be very sharp and distinct. The intruded dikes may be vertical, horizontal, or inclined at various angles. There may also be great variation in both direction and thickness. For instance, a dike may be 1,000 feet long and not more than 2 or 3 feet wide throughout much of its length but may swell at places to 50 feet or more in width.

If the crystallization is coarse and, particularly, if the dike consists of distinct bands, feldspar is more likely to occur in commercial quantities and to be free from impurities. A coarsely crystalline pegmatite consisting almost entirely of feldspar and quartz may change abruptly to a finely crystalline rock containing other minerals, and such a change renders it commercially valueless. Feldspar is thus variable both in quantity and in the nature of its occurrence; hence the reserves of any deposit can not be determined definitely. The life of most feldspar mines is therefore too uncertain to justify heavy expense for development work or mining equipment. Some operators recover as by-products certain minerals that are associated characteristically with the spar. The most important of these is mica. Enough mica is recovered at some feldspar mines to pay the expense of mining. Beryl also is sometimes recovered.

Pegmatites containing commercial feldspar have been found in about a dozen States, chiefly in the eastern part of the country in the mountainous Appalachian belt.

IMPROVED TECHNICAL CONTROL

Progressive feldspar producers and grinders are attempting to overcome the inherent lack of uniformity in their raw materials by employing technical control. By careful selection of the spar at the mine or quarry face, and by sampling, analyzing, segregating the varieties, and blending the final product, feldspar producers have greatly improved their products over those marketed a few years ago.

Such methods of control offer the greatest opportunity for modernizing the industry. Technical control is necessary even though difficult.

A knowledge of the chemical composition of the feldspar from different deposits or from different parts of the same deposit is essential, but chemical analyses should be supplemented by fusion tests as the behavior of feldspar under a fusion test may have no definite relation to its composition.

USES

The chief use of feldspar is as a constituent of both body and glaze in pottery, porcelain, white ware, vitrified sanitary ware, and enameled brick. Feldspar constitutes 10 to 35 per cent of the body of vitrified wares, in which it acts as a flux to bind the particles together. Glazes contain 30 to 50 per cent of feldspar. Enamels applied to metals are fused with feldspar. Bath tubs and wash bowls are commonly made of cast iron to which while hot an enamel containing much feldspar is applied.

Glass making is another branch of the ceramic industry in which feldspar is used. The feldspar enters into the manufacture of plate, window, and bottle glass as a source of alumina and the alkalies. It is used together with fluorspar in the manufacture of opalescent glass. The composition of feldspar closely approaches that of some types of glass. Furthermore, when a definite combination of aluminum, potash, and silica (as in feldspar) is used the constituents are assimilated more readily in the melt than if introduced separately. A recent interesting development is the substitution of kaolin for feldspar in glass manufacture. The chief purpose in adding feldspar is to supply the necessary alumina. Feldspar contains about 18 per cent of alumina, whereas kaolin may contain 39 per cent. As kaolin contains about twice as much alumina as is found in feldspar, only about half as much kaolin as spar is required per ton of sand. An advantage in the use of feldspar is its potash content, as the glass mix requires a certain percentage of alkali. It is claimed, however, that the necessary alkali can be supplied very readily by adding sodium carbonate to the mix. Kaolin of a quality suitable for use in making glass sells at about $7 per ton and therefore has some price advantage over feldspar. As several carloads of kaolin per month are now being used in place of feldspar in glass manufacture and satisfactory results have been reported, feldspar producers must face the possibility of a growing replacement of feldspar by kaolin in the glass industry, with consequent loss of some of their market.

Feldspar is also used as an abrasive in scouring soaps. As it is somewhat softer than quartz abrasives it is preferable for use in soaps designed for cleaning glass and enamel-ware surfaces which quartz would scratch. Crushed spar is used in considerable quantities in the form of granules for surfacing prepared roofing, in stucco and pebble dash, and in the facing of cement blocks, particularly those designed to resemble granite. Crushed spar graded in several sizes is sold for foundry facings. A small amount of feldspar is used as a binder in the manufacture of carborundum, corundum, emery, and other abrasive wheels. Small quantities of the purest types of potash feldspar are used in the manufacture of artificial teeth.

Experiments in the recovery of potash from feldspar continue with some promise of success, but they have not reached the point of commercial production.

The following statement indicates the approximate percentage of feldspar applied to the various uses:

Approximate percentage of feldspar used in various industries

Ceramic industry	87
Roofing, stucco, and cement-block surfacing	6.5
Scouring soaps and abrasives	3
Binder for abrasive wheels	2.5
Poultry grit and other minor uses	1

SPECIFICATIONS

The content of minerals that will not burn white is limited to a very small percentage in feldspar used for pottery and glass manufacture; especially the spar must be almost free from iron-bearing minerals, such as biotite, hornblende, tourmaline, and garnet. One-tenth of 1 per cent is now the maximum of iron oxide permitted by practically all glass manufacturers using feldspar.

No standard specification for grain size exists, although it is generally regarded that spar for ceramic use should be ground so that not more than 1 per cent will remain on a 140-mesh sieve. Some of the Trenton grinding mills have set a standard fineness of not more than 0.5 per cent on a 140-mesh screen and not more than 2 per cent on 200-mesh. For the enameling industry a more coarsely ground spar (80 to 120 mesh) may be used.

Some confusion exists as to the grading of spar. A common system of grading designates No. 1 spar as practically quartz free, No. 2 as containing not more than 25 per cent of quartz, and No. 3 not more than 30 per cent of quartz.

For opalescent glass small amounts of impurities are not objectionable, a No. 3 grade being commonly used. For glass making a soda spar is usually preferred to a potash spar. Dental spar is carefully selected white potash feldspar. Feldspar for scouring soaps and for abrasive-wheel manufacture is ground finer than for ceramic use. For the former use it should be quartz free. For roofing, cement-block surfacing, and chicken grit considerable impurity is permissible.

MINING METHODS

Open-pit quarrying is the method ordinarily followed in developing a feldspar deposit, although underground workings are to be found in some places. Feldspar is a low-priced product for which cheap and simple methods of mining must be employed. For profitable mining a deposit should yield a fair proportion of No. 1 spar. Drilling and blasting are conducted as in any other type of quarry. A face is usually opened across the entire width of the dike. It is desirable that the dike should be at least 25 feet wide. Hand sorting or " cobbing " is employed to separate the feldspar from associated quartz, mica, and other minerals. Commercial mica is commonly obtained as a by-product.

MILLING METHODS

Feldspar for all uses must be either crushed or ground. The great bulk of the production used in the ceramic industry is finely pulverized. Until recent years the usual method was either to reduce the spar to about 2-inch size in a jaw crusher or simply to sledge it to that size and then reduce it further in a chaser mill. A chaser consists of two burrstones or granite wheels 3 to 5 feet in diameter and 1 foot or more in thickness attached to radial arms carried on a vertical shaft. The wheels travel in a circle, and the spar is crushed between them and a stone bed. The material from the chasers is screened, the fines passing to pebble mills and the coarse materials returning to the chasers. Pebble mills are cylinders 6 or 7 feet long containing flint pebbles which grind the spar as the cylinders rotate. The usual charge is 2 to 3 tons of spar. It is noteworthy that steel or iron is rarely used on any of the grinding surfaces, as abrasion of the metal would contaminate the spar with iron, which is the most undesirable impurity.

Recently improved milling methods have been developed. Manganese-steel jaw crushers are used for the coarser subdivisions, and in place of the " batch " system continuous pebble mills in closed circuit with air separators are employed for the final grinding. The new mill of the Golding Sons Co. at Trenton is typical of the more modern process. In this mill the spar is first crushed to about 2-inch size and then elevated to a series of storage bins, each bin containing approximately uniform spar of known composition. A belt conveyer is employed to conduct the spar from any one or several of the bins to a second jaw crusher, which reduces it to one-half inch size. The material then passes through a dryer and is conducted to a tube mill in closed circuit with an air separator, which removes the fine material and returns the coarse to the tube mill. A notable feature of the mill is the use of poidometers for accurately weighing and proportioning the various kinds of feldspar for any required mix. Another unusual feature is the use of compressed air to convey the pulverized spar through iron pipes about 4 inches in diameter to the various storage bins. The capacity of the mill in 1928 was about 2¼ tons per hour.

The present tendency in the more modern feldspar-grinding mills is to prepare products of high purity and uniformity. The operation of a mill recently designed by the Tennessee Mineral Products Co. at Spruce Pine, N. C., is typical of the recent movement toward the preparation of dependable uniform products. Although it was realized that variations in shipments are inevitable an effort was made to hold these variations within as narrow limits as possible. To attain this end it was deemed necessary to sample the feldspar accurately and to test it before grinding. The sampling of crude feldspar is a difficult problem, and it was found necessary to employ the standard methods that custom smelters use when purchasing ores of the precious metals. The " reject " from the sampling unit passes to one of the 20 intermediate storage bins, called mixing bins, each of 80 tons capacity. As a result of careful sampling and analysis the composition of the feldspar in each bin is determined with a fair degree of accuracy. From the range of feldspar in these 20 bins mixtures in various proportions may be made, and thus practically any desired specification can be met. Past shipments can be duplicated far more closely than would otherwise be possible. The method is not infallible, but it marks a decided advance in feldspar milling.

PRODUCTION

CRUDE FELDSPAR

Crude feldspar is a term applied to the lump spar shipped from the mine or quarry, as contrasted with ground spar which is the finished product of the crushing and pulverizing mill. Statistics of production are presented separately for crude and ground spar. In accordance with the practice common in the industry, the crude is reported in long tons of 2,240 pounds and the ground in short tons of 2,000 pounds.

Crude feldspar was reported from the same States in 1928 and 1927. North Carolina continued to be the leading State, and in 1928 reported 50 per cent of the total output; New Hampshire was second with 14 per cent of the total and Maine was third with 12 per cent. Maine was the only important producing State to show a decrease in quantity and value compared with 1927.

Crude feldspar sold or used by producers in the United States, 1919–1928

Year	Long tons	Value		Year	Long tons	Value	
		Total	Average			Total	Average
1919	63,441	$347,992	$5.49	1924	204,772	$1,509,339	$7.37
1920	135,551	851,123	6.28	1925	185,706	1,315,654	7.08
1921	91,865	617.652	6.72	1926	209,989	1,607,101	7.65
1922	117,127	844,568	7.21	1927	202,497	1,424,755	7.04
1923	145,004	1,057,595	7.29	1928	210,811	1,418,975	6.73

Crude feldspar sold or used by producers in the United States, 1923–1928, by States

[Value is at mine or nearest shipping point]

State	1923		1924		1925	
	Long tons	Value	Long tons	Value	Long tons	Value
Arizona	(1)	(1)	(1)	(1)	(1)	(1)
California	9,297	$62,499	8,027	$62.344	6.077	$49,881
Colorado	(1)	(1)	(1)	(1)	(1)	(1)
Connecticut	8,780	75,379	6,572	51,422	10,426	71,201
Maine	25,029	230,122	29,912	271.354	28,404	256,731
Maryland	2,750	17,010	4,854	25,020	4,554	26,438
New Hampshire	23,220	171,789	39,425	324,638	38,366	278,736
New York	15,161	127,477	13,839	108,751	10,474	70,446
North Carolina	57,622	360,636	97,075	640,403	76,806	496,563
Pennsylvania	2,069	6,355	1,481	4,763	1,330	4,722
South Dakota	----------	----------	(1)	(1)	(1)	(1)
Virginia	(1)	(1)	(1)	(1)	(1)	(1)
Undistributed	1,076	6,328	3,587	20,644	9,269	60,936
	145,004	1,057,595	204,772	1,509,339	185,706	1,315,654

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[1] Included under "Undistributed"

Crude feldspar sold or used by producers in the United States, 1923–1928, by States—Continued

State	1926		1927		1928	
	Long tons	Value	Long tons	Value	Long tons	Value
Arizona	(1)	(1)	(1)	(1)	(1)	(1)
California	6, 271	$49, 300	5, 260	$43, 329	11, 891	$81, 199
Colorado	(1)	(1)	(1)	(1)	(1)	(1)
Connecticut	11, 436	87, 844	6. 123	43, 319	6, 292	48, 996
Maine	33, 897	306, 695	34, 328	299, 386	25, 063	202, 219
Maryland	(1)	(1)	2, 001	11, 612	2, 349	10, 325
New Hampshire	33, 271	287, 596	27, 449	223, 077	30, 343	236, 224
New York	15, 517	157, 865	12. 020	96, 446	13, 971	120, 559
North Carolina	91, 433	602, 020	100, 756	612, 214	105, 560	630, 042
Pennsylvania	1, 484	4, 492	3, 938	24, 257	2, 052	8, 851
South Dakota	(1)	(1)	(1)	(1)	(1)	(1)
Virginia	(1)	(1)	(1)	(1)	(1)	(1)
Undistributed	16, 680	111, 289	10, 622	71, 115	13, 290	80, 560
	209, 989	1, 607, 101	202, 497	1, 424, 755	210, 811	1, 418, 975

(1) Included under "Undistributed."

GROUND FELDSPAR

Probably all the feldspar consumed industrially, except that used for facing cement blocks, for covering prepared roofing, for "chicken grits," and for like purposes, is prepared by fine grinding. Even for such uses the spar is at least crushed to small sizes and more or less graded by screening, but it has not been possible to canvass all users of feldspar to determine the amounts ground and used by them. All known merchant mills or grinders—that is, those who quarry or purchase crude spar and grind it for sale to other establishments—have been canvassed during the last seven years for statistics of ground feldspar.

In 1928, 29 operators running 31 mills in 12 States reported 227,657 short tons of ground feldspar sold, a decrease of one each in the number of operators, mills, and States compared with 1927. Pennsylvania reported no ground feldspar sold in 1928. Of the mills reporting, 25 worked exclusively on domestic feldspar, 4 exclusively on imported spar, and 2 on both domestic and imported spar. Of the total quantity, 202,844 tons, or 89 per cent, was from domestic feldspar and 24,813 tons, or 11 per cent, was from imported spar, a gain in favor of domestic spar. A small quantity of Cornwall stone is imported from England and ground at Trenton, N. J.

In 1928 the average value per ton of ground feldspar from domestic crude was $14.55, a decrease of 58 cents compared with 1927 and of $2.29 compared with 1924, the year of highest recorded average; the average in 1928 ranged from $10.15 to $20.85. The average value of ground feldspar from imported crude was $20.46, a decrease of 67 cents compared with 1927. Direct comparisons of values are misleading, however, as figures for imported spar generally relate to high-grade material at mills near points of consumption, whereas the figures for domestic spar cover all grades at various points, many of which are distant from consuming centers.

The feldspar-grinding center of the United States is now in and adjacent to the great crude spar-producing State—North Carolina. For several years Tennessee, owing to favorable transportation conditions and to its proximity to North Carolina, was the largest producer of ground feldspar. Within the past two years, however, two of the Tennessee mills have been removed to North Carolina and new mills have been established in the latter State, so that in 1928, for the first time, North Carolina was the largest producer of ground feldspar; it ranked fourth in 1927 but outranked Tennessee, New York, and Maine in 1928. The North Carolina-Tennessee region has increased its share of the total feldspar ground from domestic crude in the United States from 33 per cent in 1924 to 46 per cent in 1928; Maine was third in 1928, with 13 per cent of the total, and New Jersey was fourth, with 12 per cent. New York reported 84 per cent of the feldspar ground in this country from imported crude in 1928.

Ground feldspar sold by merchant mills[1] in the United States, 1922–1928

Year	Number of operators	Domestic			Canadian[2]			Total		
		Short tons	Value		Short tons	Value		Short tons	Value	
			Total	Average		Total	Average		Total	Average
1922	20	107,969	$1,790,305	$16.58	19,075	$364,082	$19.09	127,044	$2,154,387	$16.96
1923	26	151,855	2,486,810	16.38	25,374	486,546	19.17	177,229	2,973,356	16.78
1924	30	163,905	2,760,286	16.84	25,875	522,884	20.21	189,780	3,283,170	17.30
1925	33	184,816	3,017,845	16.33	28,042	586,000	20.90	212,858	3,603,845	16.93
1926	29	199,215	3,246,174	16.29	26,147	529,623	20.26	225,362	3,775,797	16.75
1927	30	194,672	2,946,154	15.13	[2]29,243	[2]617,987	21.13	223,915	3,564,141	15.92
1928	29	202,844	2,951,281	14.55	[2]24,813	[2]507,747	20.46	227,657	3,459,028	15.19

[1] Does not include potters and others who grind for consumption in their own plants.

[2] Figures for 1927 and 1928 include some Cornwall stone.

Ground feldspar sold by merchant mills[1] in the United States, 1927 and 1928, by States

State	1927					1928				
	Number of operators	Domestic		Canadian[2]		Number of operators	Domestic		Canadian[2]	
		Short tons	Value	Short tons	Value		Short tons	Value	Short tons	Value
California	3	11,625	$201,511			3	13,778	$180,853		
Connecticut	(3)	(3)	(3)			3	2,525	36,764		
Maine	4	29,197	533,774			4	26,776	488,246		
New Jersey	4	25,344	485,446			4	24,085	459,507	(3)	(3)
New York	4	(3)	(3)	22,863	$465,944	4	(3)	(3)	20,852	$421,356
Ohio	3	(3)	(3)	6,380	152,043	3	(3)	(3)	(3)	(3)
North Carolina	2	80,563	970,323			3	93,636	1,130,349		
Tennessee	3					1				
Undistributed[4]	7	47,943	755,100			4	42,044	655,562	3,961	86,391
	30	194,672	2,946,154	29,243	617,987	29	202,844	2,951,281	24,813	507,747

[1] Does not include potters or others who grind for consumption in their own plants.

[2] Figures include some Cornwall stone ground in Ohio in 1927 and some in New Jersey in 1928.

[3] Included under "Undistributed."

[4] 1927: Colorado, Connecticut, Illinois, Maryland, New Hampshire, New York (domestic), Ohio (domestic), and Pennsylvania; 1928: Colorado, Illinois, Maryland, New Hampshire, New Jersey (imported), New York (domestic), and Ohio.

INDUSTRY BY STATES

General data.—The production of crude feldspar was reported from the same 12 States in both 1928 and 1927; in order of quantity in 1928 the States are: North Carolina, New Hampshire, Maine, New York, California, Connecticut, South Dakota, Virginia, Maryland, Arizona, Pennsylvania, and Colorado. Production (or sales) varies in most of these States from year to year, and in 1928 North Carolina and New York were the only States to maintain their respective ranks as first and fourth. The first five States, as listed above, reported 89 per cent of the total sales of crude feldspar in 1928. The principal producing region is along the Atlantic seaboard from Maine to North Carolina, and this region reported 90 per cent of the total output in 1928. Feldspar was ground in commercial mills in each of the producing States except Arizona, Pennsylvania, South Dakota, and Virginia; in addition, mills grinding feldspar were operated in Illinois, New Jersey, Ohio, and Tennessee. In California, New Jersey, New York, and Ohio mills are at or near points of consumption; in most of the other States they are near centers of feldspar mining.

Arizona.—The deposit of feldspar near Kingman, Mohave County, was operated during 1928 by the Gold Cliff Central Mining Co., Kingman, and Arizona ranked tenth in quantity and ninth in value of crude feldspar.

California.—In 1928 the quantity and value of crude feldspar reported from California increased considerably compared with 1927, and the State rose from sixth place in quantity in 1927 to fifth in 1928. The quantity of ground spar marketed in California increased in 1928 but its value decreased; the State ranked sixth in both quantity and value. A considerable part of the crude spar consumed in California in 1928 came from Arizona.

Colorado.—In 1928 the quantity and value of both crude and ground feldspar in Colorado decreased compared with 1927, and the State ranked twelfth in quantity and value of both crude and ground.

Connecticut.—Connecticut ranked sixth in quantity and value of crude feldspar and eleventh in quantity and value of ground feldspar sold in 1928; the quantity and value of the crude feldspar and the quantity of the ground feldspar increased compared with 1927, but the value of the ground feldspar decreased. Seven operators reported sales of crude and three operators reported sales of ground feldspar. The spar produced by L. W. Howe, South Glastonbury, The River Feldspar Co., Middletown, and the Tidewater Feldspar Co., Higganum, was ground in mills operated by these producers; the output of the other quarries was shipped to mills at Trenton, N. J., and East Liverpool, Ohio, where it was ground for ceramic use.

Illinois.—The mill at Murphysboro operated by the Isco-Bautz Co. (Inc.) continued running on feldspar from South Dakota.

Maine.—In 1928 Maine ranked third among the States in the quantity and value of both crude feldspar and domestic ground feldspar; in 1927 it ranked second. The quantity and value of both crude and ground spar were less than in 1927, the quantity of crude decreasing 27 per cent and the value 32 per cent, and the quantity and value of ground both decreasing about 8 per cent. Maine reported 12 per cent of the total quantity of crude feldspar and 14 per cent of its value, and furnished 13 per cent of the domestic ground spar marketed and 17 per cent of its value. Androscoggin, Oxford, and Sagadahoc were the producing counties. Most of the spar mined in

Maine is ground in mills in the State; these mills were operated in 1928 by the J. W. Cummings Feldspar Co., Bath; the Maine Feldspar Co., of Brunswick, at Auburn and Topsham; the Oxford Mining & Milling Co., of Portland, at Bates; and the Trenton Flint & Spar Co., of Trenton, N. J., at Cathance.

Maryland.—In 1928 the output of crude feldspar in Maryland increased, compared with 1927, whereas its value decreased, and the State was ninth in quantity and tenth in value of crude spar and eighth in quantity and ninth in value of ground spar. The only grinder in the State, the Seaboard Feldspar Co., Baltimore, obtained its crude spar from the quarries of the State and from Virginia.

New Hampshire.—In 1928 New Hampshire ranked second in quantity and value of crude feldspar, displacing Maine, and reported 14 per cent of the total output and 17 per cent of the total value. The quantity of crude feldspar produced in the State increased 11 per cent and the value 6 per cent compared with 1927. The discovery of an extensive deposit of high-grade feldspar near Alstead has been reported; the deposit is on property owned by the Golding-Keene Co. and is adjacent to the mines now operated by that company. The Golding-Keene Co., Keene, operated the only mill in the State. It has been reported, however, that construction work is under way on a feldspar-grinding plant for the American Mineral Products Co. (Inc.) at Cold River, and also that the Eureka Flint & Spar Co. (of Trenton, N. J.) is making plans for a mill in the same locality.

New Jersey.—New Jersey produces no crude feldspar, yet it is an important State in the industry, being a large producer of ground feldspar as well as a large consumer of that material in its pottery industry. At Trenton are the mills of the Eureka Flint & Spar Co., the Golding Sons Co., the Standard Flint & Spar Corporation, and the Trenton Flint & Spar Co. In 1928 these mills reported 24,085 short tons of ground feldspar, or 12 per cent of the total domestic production, and the State ranked fourth as a producer of domestic ground feldspar.

New York.—In 1928 New York ranked fourth in quantity and value of crude spar and seventh in quantity and value of ground feldspar from domestic quarries; it is the largest grinder of Canadian spar and ranked third in 1928 in total production of ground feldspar. Its output of crude spar in 1928 came from Fulton, St. Lawrence, and Westchester Counties. There were four active mills in the State. The mill of the Bedford Mining Co. (Inc.), Bedford, ground domestic spar only; those of the Genesee Feldspar Co. (Inc.) and the Dominion Feldspar Corporation, both at Rochester, ground Canadian spar only; and that of the New York Feldspar Corporation, Rochester, ground both domestic and Canadian feldspar. The United States Feldspar Corporation has recently completed a grinding mill at Cranberry Creek.

North Carolina.—In 1928 North Carolina was the largest producer of crude feldspar, as it has been for many years, and for the first time it was the largest producer of ground feldspar. The latter condition was brought about by the establishment of new mills and by the removal of mills to the State from Tennessee. The output of crude feldspar in North Carolina in 1928 was 50 per cent of the total for the United States and was more than three times that of New

Hampshire, the second State. Sales of crude feldspar increased 5 per cent in quantity and 3 per cent in value compared with 1927. The quantity in 1928 was the highest ever recorded for the State. The value in 1928 was the highest recorded except that in 1924, from which it was a decrease of 2 per cent. The quantity sold in 1928 was nearly three times and the value nearly four times as great as in 1918. The average value per ton of crude feldspar in 1928 was $5.97, compared with $6.08 in 1927 and $6.58 in 1926. A considerable though decreasing part of the output was made by numerous small operators who sell or barter their feldspar to some large user or central distributing agency. Two of the large buyers in 1928 were the Carolina Mineral Co. (Inc.) and the Tennessee Mineral Products Co., both of Spruce Pine. In 1928 most of the spar (about 88 per cent of the State total) was produced in Mitchell County; feldspar was produced also in Avery and Yancey Counties. Three grinding mills were operated in North Carolina in 1928—one at Spruce Pine by the Golding Sons Co. of Trenton, N. J., one at Micaville by the North State Feldspar Corporation, and one at Spruce Pine by the Tennessee Mineral Products Co. Other mills were under construction or had been completed by the Feldspar Milling Co. (Inc.), Burnsville, and by the North Carolina Feldspar Co., at Bowditch near Micaville, but they were not in operation in 1928. It was reported that Dunham & Rogers are building a new mill near Micaville. The mills in North Carolina and Tennessee reported 93,636 short tons or 46 per cent of the total domestic ground feldspar sold in 1928; it was valued at $1,130,349 or 38 per cent of the total value.

Ohio.—No feldspar is produced in Ohio, but this State and the adjacent territory in Pennsylvania and West Virginia produce more than one-half of the high-grade pottery made in the United States; hence the region is a large consumer of feldspar. The potteries in this region are partly supplied by the mills in Ohio, which are operated by the Golding Sons Co. and the Potters Mining & Milling Co., both at East Liverpool, and the Rock Products Co., at Silica, near Toledo. The Golding Sons Co. ground only domestic feldspar and the Potters Mining & Milling Co. and the Rock Products Co. marketed only Canadian spar.

Pennsylvania.—The quantity of crude feldspar sold by producers in Pennsylvania decreased 48 per cent and its value 64 per cent compared with 1927. The decrease was largely the result of the inactivity of the quarries of the Standard Flint & Spar Corporation at or near Embreeville, Chester County. A considerable part of the output of the State in 1928 was sold for poultry grit. A small amount of high-grade dental spar is reported as occasionally shipped from Brandywine Summit. Pennsylvania was at one time an important feldspar producer, ranking first among the States in 1907. The great decrease in production since 1920 has been attributed to the high cost of quarry labor and the low price of spar. The only mill in the State, that formerly operated by the American Feldspar Co. at Toughkenamon, was destroyed by fire early in 1928 and will not be rebuilt.

South Dakota.—The output of crude feldspar in South Dakota increased very greatly compared with 1927. Two quarries were active in 1928, one operated by the Abingdon Sanitary Manufacturing Co., of Abingdon, Ill., which quarries for its own use, and one operated by the Keystone Feldspar & Chemical Co., of Chicago, Ill., whose product is ground at Murphysboro, Ill.

Tennessee.—Tennessee is another State that has no feldspar mines but is important in the domestic feldspar industry. The removal of two mills from this State to North Carolina has lessened Tennessee's importance as a feldspar-grinding State and has caused it to drop from first place to second in quantity of feldspar ground. Both the mills in the State were operated in 1928 by the Erwin Feldspar Co. (Inc.) at Erwin.

Virginia.—The Seaboard Feldspar Co. (address, Baltimore, Md.) controls two quarries at Moneta in Bedford County; they were both active during 1928. The product is described as a high-grade potash feldspar used in the manufacture of ceramics. It is reported that the company is erecting a new modern grinding mill at Brookneal, for which the Moneta quarries will provide the raw material. The General Minerals Corporation of Virginia, with office in Washington, D. C., reported the production of gem feldspar in 1928 from quarries near Winterhaven Station, Amelia County.

IMPORTS[1]

The foreign trade of the United States in feldspar is small and is limited largely to imports from Canada. Before the tariff act of 1922 (September 22) imports of feldspar were not specifically classified in the official records of the Bureau of Foreign and Domestic Commerce and are therefore unknown, but from that date until the end of the year 37 long tons of crushed or ground feldspar, valued at $538, was imported. No imports of crushed or ground feldspar were recorded from 1923 to 1925, but 36 long tons, valued at $1,743, were imported in 1926; 250 pounds, valued at $3, in 1927; and 49 long tons, valued at $1,091, in 1928. The following table shows the imports of crude feldspar since the change in the tariff.

Crude feldspar imported for consumption in the United States, 1922–1928

Year	Long tons	Value	
		Total	Average
1922 (Sept. 22–Dec. 31)	7, 549	$60, 111	$7. 96
1923	24, 271	184, 924	7. 62
1924	35, 139	284, 716	8. 10
1925	24, 994	203, 524	8. 14
1926	29, 941	251, 896	8. 41
1927	27, 424	206, 856	7. 54
1928	27, 857	224, 920	8. 07

WORLD PRODUCTION

The following table shows the most recent figures of production of feldspar in the chief producing countries. Besides the United States and Canada, the important producing countries are Germany, Norway, Russia, and Sweden. Although Great Britain has an immense pottery industry, it appears to have produced no feldspar in recent years. Cornwall stone rather than feldspar is extensively used as a flux in the British pottery industry.

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[1] Figures on imports compiled by J. A. Dorsey, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.

World production of feldspar, 1924–1928, by countries, in metric tons

[Compiled under supervision of L. M. Jones, of the Bureau of Mines]

Country [1]	1924	1925	1926	1927	1928
Australia:					
New South Wales	15	33	11	[2] 16	49
South Australia [2]		10	105	93	115
Western Australia (exports)			8		
Canada (shipments)	40,645	26,019	32,614	27,078	28,936
Finland (exports)	681	753	738	553	(3)
France	5,800	3,200	10,550	(3)	(3)
Germany (Bavaria)	33,138	10,258	6,660	7,320	6,230
Great Britain	1,070				
Italy	5,200	3,400	5,878	4,054	4,960
Japan	23,427	19,049	(3)	(3)	(3)
Norway (exports)	20,875	26,785	20,510	27,650	(3)
Rumania	(3)	423	1,700	1,943	2,835
Russia [4]	3,579	8,613	18,640	19,324	(3)
Sweden	19,309	26,751	33,970	30,636	(3)
Union of South Africa			101	29	30
United States (shipments)	208,059	188,687	213,359	205,747	214,195

[1] In addition to the countries listed, feldspar is produced in Czechoslovakia. Figures of output are not available, but it is estimated that the annual production is approximately 30,500 metric tons.

[2] Includes some china stone.

[3] Data not available.

[4] Data for year ended Sept. 30.

Canada.—A considerable part of the supply of feldspar annually available for use in the United States is mined in Canada. According to reports of the Dominion Bureau of Statistics the Canadian shipments—all from Ontario and Quebec—amounted in 1928 to 28,479 long tons, valued at $284,942, or $10.01 a ton, an increase of 7 per cent in quantity and 10 per cent in total value compared with 1927.

The feldspar industry of Canada is peculiarly dependent upon the United States, to which approximately 90 per cent of the Canadian production is exported, nearly all of it in the crude state as the United States import duty on ground spar is relatively high. Canadian spar has a restricted market that is limited largely by freight rates. The market also is highly competitive and the lump spar must be delivered at grinding mills within certain price limits. With a given cost of production plus a percentage of profit, the distance that the feldspar can be profitably hauled by railroad is rather definitely fixed, and the freight charge is therefore the main factor governing Canadian production. Conditions in the United States have narrowed the market for the Canadian product to the most northerly mills, those at Rochester, N. Y., and at Toledo and East Liverpool, Ohio. Canadian feldspar is mined at Buckingham, Quebec, and at Bathurst, Hybla, and Sudbury, Ontario. Canada has provided the United States market with a notably high-grade product, but the future of the industry may be greatly influenced by pending tariff legislation.

Feldspar, produced in Canada, sold in 1919–1928

Year	Long tons	Value	Year	Long tons	Value
1919	13,106	$86,231	1924	40,004	$358,540
1920	33,815	280,895	1925	25,608	235,789
1921	26,668	230,754	1926	32,099	310,238
1922	24,756	248,402	1927	26,651	259,151
1923	26,094	237,601	1928	28,479	284,942

GRAPHITE

By JEFFERSON MIDDLETON

INTRODUCTION

This chapter presents statistics relating to graphite in 1928 and recent preceding years, together with brief textual matter on the subject.

For general information in regard to graphite the reader is referred to a series of reports on graphite published by the Bureau of Mines in four sections: Part I.—General Information; Part II.—Domestic and Foreign Deposits; Part III.—Utilization of Graphite; and Part IV.—Status of the American Graphite Industry. These reports appeared as Information Circular Nos. 6118, 6122, 6123, and 6124, respectively, and may be obtained upon application to the Director, Bureau of Mines, Washington, D. C. They treat the subject thoroughly and comprehensively and contain much information of interest and value to those engaged in the industry or interested in graphite.

PRODUCTION

In the following discussion the quantity and value of graphite sold or used by producers in the United States are presented as the best available measure of output.

During 1928 the graphite industry progressed. The quantity of natural graphite sold or used by producers in 1928 amounted to 5,611 short tons and was valued at $297,093, an increase of 8 per cent in quantity and of 28 per cent in value compared with 1927. The increase in quantity was chiefly in amorphous graphite; the quantity of crystalline was only slightly larger than in 1927. The total quantity includes 2,994 tons of amorphous and 2,617 tons of crystalline graphite, an increase of 15 per cent in amorphous but of only 0.2 per cent in crystalline. The value of the amorphous variety in 1928 was $43,320, an increase of 21 per cent over 1927, and that of the crystalline was $253,773, an increase of 29 per cent. The quantity and value of the crystalline graphite in 1928 were the largest since 1920.

The States contributing to the total in 1928 were Alabama, Georgia, Michigan, Nevada, New Jersey, Rhode Island, and Texas.

Four States reported crystalline graphite in 1928—Texas, Alabama, New Jersey, and Georgia, named in order of importance. In Alabama there were three producers reporting—the Alabama Machinery & Supply Co., Montgomery, with mine at Mountain Creek; the Superior Flake Graphite Co., Chicago, Ill., with mine at Ashland; and the Southwestern Consolidated Graphite Co., Boston, Mass., with mine at Hollins. The Alabama-Quenelda Graphite Co., Birmingham, with mine near Lineville, Ala., failed to reach the productive stage in 1928. In California the Standard Graphite Corporation, Los Angeles, was idle during 1928, as were the other graphite-producing companies in the State. In Georgia Joe Porterfield, Royston, reported the sale of a small quantity of crystalline graphite during the year. In Montana the Crystal Graphite Co., Dillon, reported only a small production for experimental purposes; the National Carbon Co. (Inc.), New York City, acquired a graphite property in Beaverhead County, but at the end of 1928 had not developed it. In Texas the only operator was the Southwestern Consolidated Graphite Co., Boston, Mass., with mine at Burnet.

Three States reported amorphous graphite in 1928—Rhode Island, Michigan, and Nevada, named in order of importance. In Michigan the only operator was the Detroit Graphite Co., Detroit, with mine at L'Anse; in Nevada the only operator was the Carson Black Lead Co., Oakland, Calif., with mine at Carson; and in Rhode Island the only operator was the Graphite Mines Co., Providence, with mine at Cranston.

Crystalline graphite was reported as having been sold in 1928 for batteries, crucibles, electrotyping, foundry facings, lubricants, paints, and stove polish. Amorphous graphite was reported as having been sold or used principally for paint manufacture.

Natural graphite sold or used by producers in the United States, 1919–1928

Year	Number of operators reporting sales	Amorphous		Crystalline		Total value
		Short tons	Value	Pounds	Value	
1919	20	3,379	$47,716	8,086,191	$731,141	$778,857
1920	17	4,694	49,758	9,632,360	576,444	626,202
1921	8	1,842	20,860	1,189,523	75,664	96,524
1922	7	2,200	(1)	1,849,766	85,242	(1)
1923	7	4,056	39,560	3,964,900	151,434	190,994
1924	5	4,071	38,533	1,800,325	48,977	87,510
1925	6	3,536	39,640	2,257,250	56,721	96,361
1926	6	2,975	40,500	4,989,200	178,842	219,342
1927	9	2,595	35,850	5,224,400	197,121	232,971
1928	9	2,994	43,320	5,233,300	253,773	297,093

[1] Bureau of Mines not at liberty to publish value.

USES

Natural graphite is used chiefly in the manufacture of foundry facings, pigments and paints, crucibles, pencils and crayons, commutator brushes, stove polish, lubricants, retorts, and batteries. During the last few years the use of graphite in the United States has undergone radical changes. Uses that a few years ago consumed a large proportion of the supply are now relatively of minor importance and uses which were unimportant have become important. Before the World War the manufacture of graphite crucibles consumed more than one-half of the supply; in 1923 only 15 per cent of the graphite used in the manufacture of finished products was used in the manufacture of crucibles and in 1924 only 13 per cent. Foundry facings used only 10 per cent of the graphite in 1913; the quantity so used in 1923 was 44 per cent, and in 1924 it was 52 per cent.

MANUFACTURED GRAPHITE

Graphite is manufactured by the Acheson Graphite Co., at Niagara Falls, N. Y. This branch of the industry was started in 1897 under patents obtained by Dr. E. G. Acheson, and was developed so rapidly that after 10 years the production of artificial graphite exceeded that of natural crystalline graphite. Since 1910, except for 1915 to 1920, the output of manufactured graphite has exceeded annually the combined output of domestic amorphous and crystalline graphite. The figures that follow are published by permission of the producing company.

Graphite manufactured by the Acheson Graphite Co., 1919–1928, in pounds

1919	8, 163, 177	1924	10, 986, 192
1920	7, 399, 749	1925	12, 135, 655
1921	5, 888, 000	1926	21, 163, 986
1922	13, 031, 926	1927	12, 257, 239
1923	26, 761, 015	1928	(1)

PRICES

In 1928 the average value of domestic crystalline graphite at the mine ranged from 1.5 to 5.8 cents per pound, compared with 2.5 to 7 cents per pound in 1927. The general average value of domestic crystalline graphite was 4.8 cents in 1928, compared with 3.8 cents in 1927.

In the following table the data for 1919 were based on information supplied by importers; since then the figures have been furnished by Charles Pettinos, of New York.

Average prices of Ceylon graphite, c. i. f. New York, 1919–1928, in cents per pound

Year	Lump		Chip		Dust		Remarks
	First grade	Second grade	First grade	Second grade	First grade	Second grade	
1919	14 -15¼	12 -13	10 -11	8 -9	6¾-7½	5 -6	Low throughout the year.
1920	9 -14	7 -11	7 -10	5½-7½	5 -7	3½-5	High first half; low second half.
1921	5½- 6	4½- 5	4½- 5	3½-4	3¼-3¾	2 -2½	Low throughout the year.
1922	5 - 6	4 - 4½	3¾- 4¼	3¼-3¾	3 -3½	2 -2½	Do.
1923	5 - 6	4 - 4½	3¾- 4¼	3¼-3¾	3 -3½	2 -2½	Do.
1924	5½- 7	4½- 6	4 - 6	3½-5	3¼-4½	2 -3	Low first three-quarters; high last quarter.
1925	7½- 9½	6½- 8½	6½- 7½	5½-6½	3½-5½	3 -4½	High throughout the year.
1926	7½- 9½	6½- 8½	6½- 7½	5½-6½	3½-5½	3 -4½	Do.
1927	7½- 9½	6½- 8½	6½- 7½	5½-6½	3½-5½	3 -4½	Do.
1928	7½- 9½	6½- 8½	6½- 7½	5½-6½	3½-5½	3 -4½	Do.

Madagascar.—The following information has also been furnished by Mr. Pettinos: The price range for 1928 for Madagascar graphite was from 6½ to 7 cents per pound, ex dock at New York, including duty and other charges.

The exports from Madagascar are virtually all of one quality, called "Standard No. 1 Flake," the grade that the French Government is attempting to have the producers maintain, with a graphitic carbon content of approximately 85 per cent. The size of grain runs from 20 to 60 mesh, virtually all passing 20 mesh and all remaining on 60 mesh.

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[1] Bureau of Mines not at liberty to publish figures.

IMPORTS AND EXPORTS [2]

In 1928 both the quantity and the value of the graphite imported for consumption increased compared with 1927; the quantity increased less than 1 per cent, but the value increased 11 per cent. The increase in total imports was due entirely to the increase of 25 per cent in quantity and 20 per cent in value of crystalline graphite imported, as imports of amorphous decreased 19 per cent in quantity and 27 per cent in value.

Amorphous graphite, which for many years constituted more than half the total quantity imported, declined to 44 per cent of the total in 1928; the value of the crystalline graphite imported, however, was 87 per cent of the total in 1928, compared with 80 per cent in 1927. The small proportion of the total value of imports represented by amorphous graphite is at least partly accounted for by the fact that the large imports from Mexico (about two-thirds of the total amorphous graphite imported) are crude graphite of low unit value.

The reports of the Bureau of Foreign and Domestic Commerce on imports show only the country from which the graphite is shipped, and that is not always the country of origin. For instance, the graphite shown as imported from France probably originated in Madagascar, that from the United Kingdom should probably be credited to Ceylon and Madagascar, and that from Belgium to Italy. The shipments credited to Japan probably consisted wholly of graphite from Chosen.

Graphite imported for consumption in the United States, 1919–1928, by kinds

Year	Amorphous		Crystalline chip or dust		Crystalline flake		Total	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1919	(a)	(a)	(a)	(a)	(a)	(a)	26,620	$2,978,096
1920							21,095	1,711,312
1921							8,[illegible]3	452,076
1922							12,458	173,046
1923	11,252	$149,831	7,243	$426,417	939	$37,871	19,434	614,119
1924	10,936	113,751	3,998	197,867	1,441	87,893	16,375	399,511
1925	9,210	143,750	5,904	389,242	2,654	293,418	17,768	826,410
1926	8,250	161,564	5,258	433,848	2,658	325,821	16,166	921,233
1927	9,559	146,881	6,116	390,822	1,777	186,220	17,452	723,923
1928	7,699	107,936	7,143	452,424	2,727	241,199	17,569	801,559

[a] Not separately classified prior to 1923.

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[2] Figures on imports and exports compiled by J. A. Dorsey, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.

Graphite imported into the United States, 1923–1928

[General imports]

Country	1923		1924		1925	
	Short tons	Value	Short tons	Value	Short tons	Value
Aden	111	$1,489	--------	--------	--------	--------
Austria	59	1,364	5	$180	--------	--------
Canada	893	37,384	1,137	58,628	2,268	$123,823
Ceylon	7,244	392,350	3,632	171,804	5,616	365,371
China	--------	--------	253	3,905	88	1,502
Chosen	1,705	24,262	251	2,768	439	5,330
Denmark	1	50	--------	--------	--------	--------
France	843	32,176	851	57,009	2,052	230,056
Germany	4	389	2	282	25	3,256
Greenland	67	600	--------	--------	--------	--------
India (British)	298	23,059	171	8,450	5	150
Italy	474	7,487	155	3,204	575	16,688
Japan	2,106	34,912	479	8,362	191	9,983
Madagascar	183	5,146	429	11,145	168	10,466
Mexico	5,765	41,339	8,984	70,380	6,159	39,119
Siam	56	2,929	--------	--------	--------	--------
Switzerland	--------	--------	17	1,944	13	1,600
United Kingdom	8	1,400	9	1,450	180	20,738
	19,817	606,336	16,375	399,511	17,779	828,082

Country	1926		1927		1928	
	Short tons	Value	Short tons	Value	Short tons	Value
Belgium	--------	--------	--------	--------	57	$4,451
Canada	2,633	$178,249	1,676	$98,079	1,048	45,594
Ceylon	4,795	390,336	5,957	367,593	6,606	421,084
China	--------	--------	9	692	--------	--------
Chosen	(1)	(1)	(1)	(1)	(1)	(1)
France	723	96,811	1,419	156,154	2,351	213,319
French Indo-China	--------	--------	2	173	--------	--------
Germany	126	13,217	7	1,089	63	5,986
India (British)	122	8,170	--------	--------	234	4,203
Italy	105	2,291	27	694	119	3,065
Japan	[1] 880	[1] 21,794	[1] 1,834	[1] 25,176	[1] 1,643	[1] 25,356
Java and Madura	61	4,041	--------	--------	--------	--------
Madagascar	1,014	108,846	162	12,459	494	37,661
Mexico	5,238	45,968	6,283	53,837	5,225	46,988
Morocco	--------	--------	42	4,529	--------	--------
Norway	14	2,078	1	61	--------	--------
Soviet Russia	--------	--------	--------	--------	1	46
Switzerland	--------	--------	3	471	--------	--------
United Kingdom	483	51,712	7	997	2	804
	16,194	923,513	17,429	722,004	17,843	808,557

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[1] Chosen included with Japan.

Graphite exported from the United States, 1919–1928

Year	Unmanufactured graphite		Manufactures of graphite [1]	Year	Unmanufactured graphite		Manufactures of graphite [1]
	Short tons	Value			Short tons	Value	
1919	629	$90,185	$788,755	1924	1,022	$144,108	$250,957
1920	607	112,771	610,261	1925	945	142,122	337,481
1921	921	95,998	679,359	1926	405	49,235	463,084
1922	569	78,094	255,019	1927	[2] 1,819	[2] 435,997	(2)
1923	908	138,542	335,778	1928	[2] 2,203	[2] 454,770	(2)

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[1] After 1921, exclusive of crucibles, figures for which are not available.

[2] Classification for 1927 and 1928 reads "Graphite and manufactures, except crucibles."

WORLD PRODUCTION

The following table shows, so far as figures are available, the production of natural graphite throughout the world from 1924 to 1928.

World production of natural graphite, 1924–1928, in metric tons

[Compiled under supervision of L. M. Jones, of the Bureau of Mines]

Country	1924	1925	1926	1927	1928
Australia:					
New South Wales	----------	----------	----------	10	----------
Northern Territory	3	----------	----------	----------	----------
Austria	9,523	13,079	14,756	18,058	24,226
Brazil	(1)	----------	----------	----------	9
Canada	1,210	2,331	2,474	1,659	994
Ceylon [2]	9,806	15,674	11,810	13,091	14,576
Chosen [2]	16,032	15,040	18,692	20,331	22,839
Czechoslovakia	11,935	18,466	30,818	41,113	32,332
France	514	1,139	950	900	(3)
Germany	10,079	16,853	14,304	17,773	17,464
Greenland [4]	53	32	----------	----------	----------
Indo-China	2,264	[4] 221	[4] 815	[4] 410	(3)
Italy	7,740	9,937	9,605	8,395	7,030
Japan	767	1,010	498	633	(3)
Madagascar [2]	11,556	14,980	11,454	14,329	13,897
Mexico (amorphous)	8,023	6,264	4,435	5,837	4,972
Russia [5]	169	2,485	6,425	6,857	(3)
Spain	----------	1,945	603	352	(3)
Union of South Africa	50	47	46	58	51
United States:					
Amorphous	3,693	3,208	2,699	2,354	2,716
Crystalline	816	1,024	2,263	2,370	2,374

[1] 50 kilos.
[2] Exports.
[3] Data not available.
[4] Concentrates.
[5] Year ended Sept. 30.

WORLD GRAPHITE SITUATION DURING 1928

The following paragraphs quoted from a paper on the world graphite situation during 1928, by F. H. Blumenthal, of the minerals division, Bureau of Foreign and Domestic Commerce, and published by the United States Department of Commerce in Commerce Reports No. 9, March 4, 1929, may be of interest. The figures of imports for 1928 in this paper were given subject to revision and differ slightly from later figures shown on preceding pages of this chapter.

United States imports of all varieties of graphite during 1928 amounted to 35,181,575 pounds, valued at $807,719—an increase of 324,353 pounds (1 per cent) and $85,715 (12 per cent) over the 1927 receipts of 34,857,222 pounds, valued at $722,004. As will be seen later, this more than proportionate increase in value can be attributed to the increased imports of crystalline flake and lump graphite, accompanied by a decline in entries of the amorphous variety rather than to a general rise in the world price of graphite.

The entries during 1928 were composed of 15,442,551 pounds of amorphous graphite, 5,453,741 of crystalline flake graphite, and 14,285,282 of crystalline lump.

* * * Mexico supplied approximately two-thirds of the amorphous graphite, Madagascar about 97 per cent of the crystalline flake, the greater part of which was transshipped through France, and Ceylon 94 per cent of the crystalline lump. In comparison with 1927 the 1928 figures show a decline of 18 per cent in imports from Mexico, an increase of 67 per cent in those from Madagascar and France combined, and an increase of 12½ per cent in receipts from Ceylon. Total imports of all varieties from Canada declined more than one-third from the 1927 record, and receipts from Japan were 18 per cent less.

The London Mining Journal, quoting an address of the president of the Ceylon Plumbago Merchants' Association at its annual meeting, says that little progress has been made in restoring the Ceylon graphite industry to its former favored position, when it gave employment to over 50,000 people. It is now estimated that the industry is operating at less than 50 per cent of its maximum capacity. Divergent points of view were expressed as regards steps to rehabilitate the industry. One opinion was that the United Kingdom, which is now purchasing the major part of its requirements from Madagascar, could supply a market sufficient to put the Ceylon industry on its feet if a preferential tariff favoring Ceylon graphite were enacted. Discounting this proposal, other authorities believed that the only remedy for the situation lay in reducing production costs to a point where the product could compete unaided with that of Madagascar. It was further suggested that a plumbago exchange would reduce costs by bringing the small producer in direct contact with the exporter.

Conditions in the Madagascan graphite industry in 1928 were far from satisfactory, according to a report from Vice Consul John S. Richardson, jr., Tananarive. While exports approximating 24,000,000 pounds during the first nine months of the year represented an advance over 20,550,000 pounds shipped during the corresponding period of 1927, this trade was effected at constantly falling prices. Stocks accumulated until they were estimated at about 10,000 tons at the end of September. This condition resulted in the temporary withdrawal from the local market of the Maskar Co., a British firm, and the only large cash purchaser in Madagascar. Small producers dependent on this company as an outlet for their product have been forced to cease operations. During the year the Government reduced the export tax and also lowered the freight rates on graphite carried by State railroads between Tananarive and Tamatave.

The continuing depression has made it increasingly apparent that the present graphite production capacity of Madagascar is in excess of requirements of the developed outlets.

Reports from Consul General Ransford S. Miller, Seoul, indicate that exports of graphite from Chosen increased appreciably during the first nine months of 1928 over those for the corresponding period of the preceding year. The increase occurred entirely in shipments of amorphous graphite—from 21,980,000 pounds, valued at $251,900, in the first nine months of 1927, to 35,200,000 pounds, worth $290,000, in the corresponding 1928 period. Shipments of flake declined—from 4,690,100 pounds, $129,550, in the nine months of 1927, to 2,915,000, $97,200, in the 1928 period. Total shipments, therefore, amounted to 38,115,000 pounds, valued at $387,200, in the 1928 period, as compared with 26,670,100 pounds, worth $381,450, in the 1927 months.

The greater part of this export has been going to Japan, where a portion has been reexported. During the third quarter, however, new shipping arrangements were effected whereby the rate of $10 a ton between Japan and the United States was extended to include Chosen, which may presage the direct exportation of graphite to the United States in the future rather than transshipment through Japan.

A small strike occurred during the third quarter in the northern mines, where flake graphite is produced. This is expected to diminish somewhat the final figure for annual production.

The graphite mining industry of Mexico is centered in the State of Sonora. A report from Consul Herbert S. Bursley, Guaymas, Sonora, states that the entire output originally is consigned by rail to the United States and that production corresponds closely to this export. Shipments during 1928 were 15 per cent under those for 1927 and 9½ per cent above those for 1926—in 1928, 11,065,079 pounds, $53,112; 1927, 12,882,228 pounds, $55,961; and 1926, 10,107,987 pounds, $45,917.

During the first 10 months of 1928 Italian exports of graphite increased 15 per cent over those for the corresponding period of 1927 and 9½ per cent over those for January-October, 1926, according to a report from Consul William Oscar Jones, Rome. In the first 10 months of 1926 these shipments totaled 7,275,000 pounds, valued at $62,450; in the corresponding months of the following year, 6,910,000 pounds, valued at $71,820; and in the 1928 period, 7,975,000 pounds, valued at $81,856.

About 83 per cent of the 1928 export was consigned to France, Great Britain, Belgium, and Germany, whereas approximately 2½ per cent was shipped to the United States.

A report from Consul Leon Dominian, Rome, places the estimated production of graphite in Italy during 1928 at 13,250,000 pounds. This compares with a production of 18,550,000 pounds during 1927 and represents a decline of 28½ per cent.

During the year attention has been directed to other countries, which previously have produced no graphite or only negligible quantities. E. A. Masuret, office of the commercial attaché, Paris, reports that production by the one operating company in French Indo-China is increasing steadily. The output, said to be of the flake variety, running about 20 per cent graphitic carbon, has necessitated the erection of a refining plant at the mine.

The following extract from the Mining Journal, London, March 23, 1929, page 222, in regard to graphite mining in Ceylon in 1928, may also be of interest.

In the annual report of the Ceylon Chamber of Commerce the position of Ceylon graphite in 1928 is reviewed thus:

Although the exports of plumbago from Ceylon during 1928 showed an increase of 1,440 tons over 1927, the average price realized was less by Rs. 7.49 per ton. The actual exports for 1928 were 14,346 tons with an average value per ton of Rs. 188.51, compared with 1927 exports of 12,906 tons with an average value of Rs. 196.00 per ton. The demand during the year was principally for carbon lump plumbago and chips, dust, and flying dust. There was very little demand for high-grade crucible plumbago. This was no doubt due to the large supplies exported from Madagascar, where improved methods of treating the ore make it possible to supply plumbago suitable for most kinds of crucibles at a much lower rate than the best grades of Ceylon plumbago. Owing to the low average rates obtainable, very few mines in the island are working, and the only chances for a real revival in the industry appear to be an increase in the demand from India, the Far East, and Australia, where Ceylon would not have to contend with Madagascar competition.

POTASH

By A. T. Coons

PRODUCTION AND SALES

Potassium salts produced in the United States in 1928 contained the equivalent of 59,910 short tons of potash (K_2O), the largest quantity yet recorded and an increase of 38 per cent over 1927. The average content calculated as potash (K_2O) in the salts produced was 57.5 per cent in 1928, as compared with 56.6 per cent in 1927.

Total production of potassium salts in 1928 was 104,129 short tons—35.6 per cent more than in 1927. Sales of potassium salts were 11 per cent more and the potash equivalent of the material sold 22 per cent more than in 1927. The total value of the potassium salts sold was 24 per cent more than in 1927; the value per unit (20 pounds of K_2O) was 50 cents in 1928, as compared with 49 cents in 1927. Both production and sales were larger in 1928 than in any other year since 1920. As in 1925, 1926, and 1927, the sales were larger than the production.

The stocks remaining in producers' hands decreased about 14 per cent. The same number of plants reported production and also sales in 1928 as in 1927, and one less reported stocks remaining on hand.

Tables of sales by States and by sources are omitted to avoid disclosing individual production. A summary of production, sales, and producers' stocks of potassium salts in the United States for the past 11 years is given in the following table.

Potassium salts produced, sold, and in stock in the United States, 1918–1928

Year	Production			Sales				Stocks		
	Number of plants	Potassium salts (short tons)	Equivalent as potash (K_2O) (short tons)	Number of plants	Potassium salts (short tons)	Equivalent as potash (K_2O) (short tons)	Value f. o. b. plant	Number of plants	Potassium salts (short tons)	Equivalent as potash (K_2O) (short tons)
1918	128	207, 686	54, 803	(1)	140, 343	38, 580	$15, 839, 618	(1)	67, 343	16, 223
1919	102	116, 634	32, 474	(1)	166, 063	45, 728	11, 271, 269	(1)	(1)	(1)
1920	66	166, 834	48, 077	64	139, 963	41, 444	7, 463, 026	38	32, 378	8, 999
1921	20	25, 485	10, 171	23	10, 337	4, 408	447, 859	30	32, 925	12, 625
1922	12	25, 176	11, 714	16	22, 028	11, 313	463, 512	16	30, 100	11, 653
1923	12	39, 029	20, 215	11	35, 164	19, 281	784, 671	14	34, 794	12, 363
1924	12	43, 734	22, 903	9	37, 492	21, 880	842, 618	11	32, 389	10, 770
1925	9	51, 565	25, 448	7	52, 823	25. 802	1, 204, 024	7	[2] 30, 919	10, 276
1926	7	46, 324	23, 366	6	51, 369	25, 060	1, 083, 064	4	[3] 26, 000	[3] 9, 000
1927	9	76, 819	43, 510	5	94, 722	49, 500	2, 448, 146	8	7, 250	2, 500
1928	9	104, 129	59, 910	5	105, 208	60, 370	3, 029, 422	7	6, 260	2, 100

[1] Figures not available.
[2] Of this quantity 212 tons was lost by leaching, etc.
[3] Estimate.

PRODUCING LOCALITIES

In 1928 the potassium salts produced were from natural brines, from flue dusts of blast furnaces, from the waste from molasses distillation, and from Steffen's water. A small amount of alunite was utilized for experimental work. The American Potash & Chemical Corporation, 233 Broadway, New York, N. Y., the chief American producer of potassium salts, also recovered borax and other natural sodium salts as by-products from its plant at Trona (Searles Lake), San Bernardino County, Calif. Its output of potassium salts increased 34 per cent in 1928, and somewhat less was marketed than produced. The product sold by this company has a higher equivalent of potash (K_2O) than that of any other company, and the per cent in 1928 (61.48) was higher than in 1927 (60.14). The plant of the United States Industrial Chemical Co. (address, 110 East Forty-second Street, New York, N. Y.), at Baltimore, Md., was the second largest producer of potassium salts in 1928. The salts averaged 33 per cent K_2O, were mixtures of sulphates, chlorides, and small amounts of carbonates, and were recovered from the waste from molasses distillation. The company's sales in 1928 were slightly less than its production. Potassium salts (chiefly sulphates), from flue dusts of blast furnaces, were produced and sold at the Lucy and Isabella furnaces of the Carnegie Steel Co. (Pittsburgh, Pa.). A small amount of alunite shipped from Marysvale, Utah, by the American Alunite Chemical & Fertilizer Co. and by the Marysvale Cash Store was used for experimental tests. The Holland-St. Louis Sugar Co., Holland, Mich., sold potassium salts (in the form of concentrated Steffen's waste water) from its plant at Decatur, Ind.

The results of investigations of potash deposits in Texas, New Mexico, and other potash-bearing localities, as carried on by the Bureau of Mines, the Geological Survey, and other Government bureaus, are published in separate pamphlets and are not reviewed here.

IMPORTS AND EXPORTS[1]

Imports of potash materials are shown in the following tables. The materials are classified as salts used chiefly in the fertilizer industry and as those used chiefly in the chemical industries. The former class, which includes kainite, manure salts, muriate, and sulphate, accounted for nearly 94 per cent of the total potash (K_2O) imports in 1928.

Information furnished to the Bureau of Mines by several of the large buyers of fertilizers and by the importers regarding the quantity of the different grades of manure salts imported has made advisable a change in the estimated percentages used in calculating the potash (K_2O) equivalent of the different materials classed as fertilizer salts. From the information received it is obvious that the calculated potash (K_2O) equivalent of the imported salts has been too low. The 1927 figures have been recalculated on the basis used for 1928.

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[1] Figures on quantity and value of imports and exports compiled by J. A. Dorsey, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.

Potash materials imported for consumption in the United States, 1927–28

Material	Approximate equivalent as potash (K_2O) (per cent)	1927				1928			
		Short tons	Approximate equivalent as potash (K_2O)		Value	Short tons	Approximate equivalent as potash (K_2O)		Value
			Short tons	Per cent of total			Short tons	Per cent of total	
Used chiefly in fertilizers:									
Kainite	14.0	115,345	16,000	6.6	$815,009	119,897	17,000	5.1	$886,706
Manure salts	24.0	311,357	75,000	30.7	3,676,535	453,242	109,000	33.0	5,251,200
Muriate (chloride)	52.0	183,475	95,000	38.9	5,739,097	261,644	136,000	41.2	8,181,703
Sulphate	50.0	77,172	39,000	16.0	2,947,969	96,833	48,000	14.5	3,908,221
		687,349	225,000	92.2	13,178,610	931,616	310,000	93.8	18,227,830
Used chiefly in chemical industries:									
Bicarbonate	46.0	242	111	7.8	28,125	181	83	6.2	19,935
Bitartrate (argols)	20.0	12,451	2,490		2,288,968	6,445	1,289		1,330,645
Bitartrate (cream of tartar)	25.0	130	33		50,030	68	17		26,824
Bromide	39.6	10	4		7,075	12	5		7,918
Carbonate, crude	61.0	6,596	4,024		619,430	8,456	5,158		768,829
Carbonate, crude or black salts	50.0								
Carbonate, refined	67.0								
Caustic	80.0	7,380	5,904		915,811	5,824	4,659		686,479
Chlorate and perchlorate	36.0	6,696	2,411		495,741	6,290	2,264		461,161
Chromate and bichromate	40.0	3	1		906	3	1		1,112
Cyanide	70.0	170	119		70,077	58	41		43,590
Ferricyanide (red prussiate)	42.0	52	22		28,439	59	25		32,984
Ferrocyanide (yellow prussiate)	44.0	80	35		21,181	67	29		16,846
Iodide	28.0	--------	--------		---------	(1)	(1)		16
Nitrate (saltpeter), crude	40.0	4,826	1,930		228,029	10,835	4,334		376,405
Nitrate (saltpeter), refined	46.0	4,215	1,939		347,290	5,305	2,440		416,052
Permanganate	29.0	160	46		26,931	300	87		54,259
Rochelle salt	22.0	115	25		27,192	39	9		10,165
All other	50.0	122	61		35,970	103	52		38,942
		43,248	19,155	7.8	5,191,195	44,045	20,493	6.2	4,292,162
Grand total	---------	730,597	244,155	100.0	18,369,805	975,661	330,493	100.0	22,519,992

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(1) Quantity of iodide imported was 4 pounds.

In 1913—the last normal year before the war—when the entire supply was imported, the United States imported the equivalent of 272,457 short tons of potash (K_2O); in 1928 the imports were 330,493 tons, or more than 1.2 times that amount, and 1928 is the only year during this period that the imports of 1913 have been exceeded. The imports in 1928 were about 5.5 times the production in the United States in that year. The combined imports and domestic production in 1928 were 1.4 times the imports in 1913.

Approximate equivalent as potash (K_2O) of potash-bearing materials imported for consumption in the United States, 1919–1928, in short tons

1919	39,619	1924	200,365
1920	224,792	1925	258,217
1921	78,698	1926	266,280
1922	201,415	1927	244,155
1923	209,950	1928	330,493

The following table indicates the amount of potash-bearing materials imported in 1928 and the countries from which last shipment was made. Virtually all of the crude salts and much the larger part of the refined salts imported originated in Germany and France.

Potash materials imported into the United States in 1928, in short tons

[General imports. The figures in parentheses in the column headings indicate in per cent the approximate equivalent as potash (K_2O)]

Country	Muriate (chloride) (52)	Sulphate (50)	Manure salts (24)	Kainite (14)	Bitartrate		Caustic (80)	Carbonate (61)	Cyanide (70)	Nitrate (saltpeter) crude (40)	Chlorate and perchlorate (36)	All other (50)	Total	
					Argols or wine lees (20)	Cream of tartar (25)							Short tons	Value
Africa:														
Algeria and Tunisia					59								59	$14,044
Union of South Africa					8								8	1,841
Argentina					429								429	60,843
Belgium	98,564	5,300	137,359	34,935				41		82	153	19	276,453	5,201,752
Canada	1,133					(1)				110			1,243	53,191
Chile					114					9,979			10,093	337,462
China								1					1	260
Czechoslovakia							33	145				103	281	32,823
France	329	74	3,362	209	3,401	51				217	355	134	8,132	881,895
Germany	143,197	90,813	299,360	84,064	55		5,634	7,486	52	445	5,796	5,390	642,292	14,544,247
Hong Kong								1					1	257
Italy		(1)			1,178	10							1,188	246,827
Japan								(1)					(1)	16
Netherlands	7,082	646	12,761	689			11	782		2		316	22,289	490,173
Portugal					798								798	153,888
Spain	11,339				403								11,742	397,622
Sweden							146				4		150	31,879
Switzerland											257	2	259	38,399
United Kingdom			400			19			6			56	481	39,358
	261,644	96,833	453,242	119,897	6,445	80	5,824	8,456	58	10,835	6,565	6,020	975,899	22,526,777
Approximate equivalent as potash (K_2O)	136,000	48,000	109,000	17,000	1,289	20	4,659	5,158	41	4,334	2,363	3,010	330,874	

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[1] Less than 1 ton.

In connection with the foregoing table of imports, the following tables showing distribution of the sales of French and German potash (K_2O) and the total production in those countries are of interest; the figures are taken from published reports of the Bureau of Foreign and Domestic Commerce and are based on information furnished chiefly by the representatives abroad of the syndicates controlling the sales of the French and German salts. The figures of production given in these tables do not entirely agree with those given on page 96; the latter were compiled by the Bureau of Mines from foreign official sources.

Potash (K_2O) produced in France and sold, 1919–1928 [1]

Year	Production (metric tons)	Sales						
		Domestic		Foreign				Total (metric tons)
				United States		Other foreign		
		Metric tons	Per cent of total	Metric tons	Per cent of total	Metric tons	Per cent of total	
1919	94, 189	47, 053	51. 2	23, 389	25. 4	21, 560	23. 4	92, 002
1920	194, 841	86, 264	43. 3	58, 128	29. 2	54, 674	27. 5	199, 066
1921	143, 788	54, 433	53. 0	17, 917	17. 5	30, 308	29. 5	102, 658
1922	210, 365	66, 288	29. 1	41, 202	18. 1	120, 275	52. 8	227, 765
1923	250, 208	80, 929	34. 0	83, 194	35. 0	73, 642	31. 0	237, 765
1924	269, 783	98, 546	35. 9	76, 827	28. 0	99, 104	36. 1	274, 477
1925	303, 385	124, 007	37. 6	98, 468	29. 8	107, 245	32. 6	329, 720
1926	352, 034	154, 916	44. 1	85, 431	24. 3	110, 640	31. 6	350, 987
1927	333, 273	145, 953	46. 0	66, 663	21. 0	104, 904	33. 0	317, 520
1928	427, 997	201, 967	50. 0	83, 590	20. 7	117, 840	29. 3	403, 397

[1] 1919–1923: U. S. Dept. Commerce, Trade Promotion Series, No. 33; 1924–1928: World Trade Notes on Chemicals and Allied Products, July 22, 1929.

Potash (K_2O) produced in Germany and sold, 1918–1928 [1]

Year	Production (metric tons)	Sales						
		Domestic		Foreign				Total (metric tons)
				United States		Other foreign		
		Metric tons	Per cent of total	Metric tons	Per cent of total	Metric tons	Per cent of total	
1918	1, 135, 965	859, 716	85. 8	----------	----------	141, 948	14. 2	1, 001, 664
1919	944, 779	637, 033	78. 5	70, 129	8. 6	104, 840	12. 9	812, 002
1920	1, 297, 396	689, 391	74. 6	83, 602	9. 1	150, 650	16. 3	923, 643
1921	1, 054, 213	768, 477	83. 4	39, 515	4. 3	113, 155	12. 3	921, 147
1922	1, 510, 910	963, 582	74. 4	109, 608	8. 5	222, 354	17. 1	1, 295, 544
1923	1, 280, 437	535, 106	60. 4	104, 623	11. 8	246, 213	27. 8	885, 942
1924	1, 014, 146	502, 456	59. 7	111, 636	13. 2	227, 969	27. 1	842, 061
1925	1, 572, 327	767, 165	62. 6	176, 541	14. 4	281, 807	23. 0	1, 225, 513
1926	1, 260, 047	694, 274	63. 1	136, 350	12. 4	269, 249	24. 5	1, 099, 873
1927	1, 518, 724	779, 941	62. 9	156, 195	12. 6	303, 236	24. 5	1, 239, 372
1928	1, 690, 469	869, 289	61. 1	165, 822	11. 7	386, 276	27. 2	1, 421, 387

[1] U. S. Dept. Commerce, World Trade Notes on Chemicals and Allied Products, June 17, 1929.

Potassium salts exported from the United States, 1922–1928

Year	Short tons	Value	Year	Short tons	Value
1922	6, 238	80, 996	1926	1, 679	$319, 201
1923	3, 997	05, 837	1927	1, 965	487, 726
1924	1, 923	01, 036	1928	2, 619	609, 018
1925	2, 155	98, 740			

CONSUMPTION

The consumption of potash in the United States in 1928, as indicated by imports plus sales of domestic products (exports being negligible), was 1,080,869 short tons of material equivalent to approximately 390,863 tons of K_2O—an increase of 33 per cent in quantity of K_2O compared with 1927. Of the totals in 1928, 10 per cent of the material containing 15 per cent of the K_2O was produced in this country. About 95 per cent of the total supply was used in the manufacture of fertilizers.

MARKET CONDITIONS

Market conditions showed little change from those of the preceding year. As cotton, tobacco, and "truck" are the chief potash-consuming crops, the States east of Mississippi River and south of Ohio River and the Mason and Dixon line are the chief users of potash, although in the Northeastern States potash is used for growing potatoes and other vegetables. The prices at which foreign potash has been available have continued to curb American production and particularly to discourage the launching of new enterprises.

PRICES

The American sales agent for the French and German potash syndicates announced in April, 1928, that the potash prices covering the period May 1, 1928, to April 30, 1929, would remain the same as those for the season May 1, 1927, to April 30, 1928, with special discounts for early purchase and shipment. The prices in 1928 and 1927 are the same as those that prevailed at the end of the year 1926 and are given in the following table for comparison with those in 1925.

Prices of different grades of potassium salts at end of year, 1925–1928

[On orders for a minimum of 50 tons in bags or 200 tons in bulk]

		1925	1926 to 1928
Sulphate, 90 to 95 per cent	in bags	$45.85	$47.30
	in bulk	44.60	45.70
Muriate, 80 to 85 per cent	in bags	34.90	36.40
	in bulk	33.65	34.80
Potash-magnesia sulphate (double manure salts), 48 per cent	in bags	26.35	27.25
	in bulk	25.10	25.65
Manure salts, 30 per cent	in bags	20.00	21.75
	in bulk	18.00	18.75
Manure salts, 20 per cent	in bags	13.35	15.40
	in bulk	11.35	12.40
Kainite, 14 to 16 per cent	in bags	10.50	12.50
	in bulk	8.50	9.50
Kainite, 12.4 per cent	in bags	10.00	12.00
	in bulk	8.00	9.00

The discounts that applied until May 1, 1928, were given in the report of this series for 1927. According to the Oil, Paint & Drug Reporter the following discounts were offered beginning May 1, 1928: On orders placed prior to June 1 for prompt shipment, 8 per cent; prior to June 1 for shipment in equal monthly quantities June to September, inclusive, 7 per cent; July 1 for July shipment, 7 per cent; August 1 for August shipment, 6 per cent; September 1 for September shipment, 5 per cent; October 1 for October shipment, 4 per cent; November 1 for November shipment, 3 per cent; December 1 for December shipment, 2 per cent. Prices are guaranteed against seller's decline in the continental United States until April 30, 1929. Bagged salts are sold on foreign weights, tares, and analyses; bulk salts on American weights and foreign analyses.

SUMMARY OF WORLD PRODUCTION

The following table, compiled by L. M. Jones, of the Bureau of Mines, lists the countries that in the last five years have produced potassium salts, and gives the available figures for their production of crude salts and K_2O equivalent. The list of countries differs somewhat from that given in the table of imports, because in that table some of the countries from which the imports came were not themselves producers but received their supply from other countries. Both tables, however, clearly show the predominance of Germany and Alsace as producers of potash. Further data on production and exports of potash in France and Germany over a series of years are given in tables on page 93.

World production of potash minerals and equivalent K_2O, 1924–1928, in metric tons

Country and mineral [1]	1924		1925		1926		1927		1928	
	Output	Equivalent K_2O	Output	Equivalent K_2O	Output	Equivalent K_2O	Output	Equivalent K_2O	Output	Equivalent K_2O
Australia: New South Wales, alunite	1,024	89	540	45	589	51	-------	-------	-------	-------
China [2]	587	(3)	336	(3)	(3)	(3)	(3)	(3)	(3)	(3)
Ethiopia, crude salts	-------	-------	-------	-------	1,635	(3)	1,600	800	1,300	650
France (Alsace), crude salts	1,664,605	[4] 271,625	1,926,346	[4] 311,892	2,316,546	[4] 366,670	2,321,775	[4] 372,260	2,580,196	[4] 410,635
Germany, crude salts	8,091,117	[4] 895,600	12,029,576	1,574,839	9,408,109	1,262,589	11,071,541	1,518,037	12,488,000	1,690,469
India (British), nitrate of potash	8,680	3,472	[5] 7,300	[5] 3,000	[5] 5,800	[5] 2,000	[5] 6,900	[5] 3,000	(3)	(3)
Italy:										
Alunite	852	97	1,500	170	1,600	180	800	90	195	20
Leucite rock	15,600	1,264	226,000	18,000	35,000	2,800	29,000	2,300	39,200	3,200
Japan, alunite	10	1	113	13	(3)	(3)	(3)	(3)	(3)	(3)
Poland:										
Kainite	23,545	2,355	62,823	6,282	79,166	7,917	127,772	12,772	146,692	14,669
Sylvinite	57,875	15,626	115,980	31,315	128,523	31,025	148,340	31,053	194,964	40,942
Russia: [6]										
Alum stone	1,625	(3)	1,042	(3)	647	(3)	1,364	(3)	(3)	(3)
Alunite clays	500	(3)	1,125	(3)	3,305	(3)	3,065	(3)	(3)	(3)
Carbonate of potash [7]	2,803	(3)	3,967	(3)	3,136	(3)	3,784	(3)	(3)	(3)
Spain:										
Crude salts	-------	-------	27,734	4,021	80,598	11,687	172,356	17,236	243,233	(3)
Potassic earth	1,000	29	1,000	29	950	(3)	950	(3)	850	(3)
United States, crude salts	39,675	20,777	46,779	23,086	42,024	21,197	69,689	39,471	94,464	54,349

[1] In addition to the countries listed, Queensland produced 6 tons of alunite in 1927, but working expenses equaled returns and operations were discontinued.
[2] Exports.
[3] Data not available.
[4] Figures relate to merchantable products.
[5] Estimated production (Imperial Institute, London).
[6] Year ended Sept. 30.
[7] Made from sunflower ash. The deposits of Solikamsk not yet on a producing basis.

ASBESTOS

By Oliver Bowles and B. H. Stoddard

PROPERTIES OF ASBESTOS

The term "asbestos" is applied commercially to minerals that may be readily separated into flexible fibers. This fibrous structure permits the higher grades to be spun or woven, as in ordinary textile operations, producing fabrics that are fireproof, weatherproof, and only slightly acted upon by acids. In many products and processes a mineral having these unique properties is regarded as essential, no suitable substitute having been found for it.

VARIETIES

The chief commercial types of asbestos are defined as follows:

Chrysotile is a hydrous magnesium silicate represented by the chemical formula $H_4Mg_3Si_2O_9$. It has the same composition as serpentine, with which it is always associated. Commercially it is the most important of all the varieties.

Anthophyllite is an anhydrous iron-magnesium silicate having the composition $(Fe,Mg)SiO_3$. The fiber is usually brittle and of low tensile strength. It is used for nonspinning purposes and is more resistant than chrysotile to the action of acids and heat.

Crocidolite is a soda-bearing amphibole having the composition $NaFe(SiO_3)_2FeSiO_3$. On account of its characteristic color it is commonly called "blue asbestos." It is used for spinning.

Amosite is a variety of anthophyllite that contains iron instead of magnesia. It is a spinning asbestos notable for its great fiber length.

Tremolite, having the composition $CaMg_3(SiO_3)_4$, and *Actinolite*, having the composition $Ca(Mg,Fe)_3(SiO_3)_4$, are amphiboles that may be classed as asbestos when they occur in fibrous form; they are the minerals, in fact, to which the term "asbestos" was first applied. The fibers are weak and brittle and are of little value commercially at present.

USES

Commercially asbestos falls into two great divisions—the spinning and the nonspinning fiber.

The spinning fiber may be subdivided into various classes, each depending on its quality and the nature of the product for which it is best adapted. The largest use of spinning asbestos is for the manufacture of automobile brake-band linings and clutch facings. Other important uses are for fireproof theater curtains, firemen's suits, and gloves.

Short fibers and the nonspinning varieties are used in shingles, wall board, pipe coverings, paper and mill board, telephone parts, cements for boiler coverings, and with asphalt for roof coating.

Asbestos cement is widely used for heat insulation on steam and water pipes, in cold-storage plants, and as a lining in safes, stoves, and furnaces. Asbestos paper is used extensively in the building industries.

In the laboratory asbestos is used for acid filters, for stoppings in combustion tubes, for fireproof supports and protectors, and for wicks in producing colored flame by saturation with mineral salts. A multitude of industries use it for hundreds of minor purposes.

GRADES

The most valuable grades of asbestos are the hand-cobbed fibers, Nos. 1 and 2 crude, which are graded according to length. From these grades the highest types of asbestos fabrics are made.

Mill fiber is graded and classified according to length in the standard Canadian testing machine, which sorts it into four grades—plus 2 mesh, minus 2 plus 4 mesh, minus 4 plus 10 mesh, and minus 10 mesh. The screen test of any sample is given in four figures, representing the number of ounces per pound in each of the foregoing grades. The following table gives the standard screen tests for the various grades.

Standard screen tests for the various grades of asbestos

Grade according to use	Screen test
Long spinning fiber	2–8–4–2
Medium spinning and compressed sheet fiber	0–8–6–2
Shingle stock	0–1½–9½–5
Paper and mill board stock	0–0–10–6
Cement stock	0–0–5–11

CHIEF SOURCES

The United States uses more asbestos than any other country but produces only a very small fraction of its requirements. Canada and Africa supply a very large percentage of the raw material used in this country. Just two varieties of asbestos are mined in the United States—chrysotile and anthophyllite. In 1928 chrysotile asbestos was mined in the United States in Arizona only. The general increased demand for high-grade chrysotile so stimulated development in Arizona that the commercial production in that State in 1928 was even greater than it was in 1927, when it was more than double that in 1926. The production in 1928 consisted almost entirely of Nos. 1 and 2 crude, and the average price was about $290 a short ton. The average price of all grades of Canadian fiber in 1928 was $41.16 a short ton. The great difference in average price between these two localities is due to the fact that great quantities of the lower-priced short fibers are shipped from Canada, whereas very little short fiber can be profitably shipped from Arizona, as the deposits are so remote from markets.

MARKET CONDITIONS

The upward trend of prices continued in 1928, particularly for the higher grades. Crude No. 1 averaged about $85 a ton higher in 1928 than in 1927. In general, the industry was highly prosperous throughout the world. Expansion of uses has led to continually increasing production capacity to meet the growing demands. Part of the year several manufacturers were somewhat perplexed about a shortage of spinning fiber, but the situation was not acute enough to necessitate the closing of any plants for lack of material. Some have predicted that this shortage will continue during a part at least of 1929. Shingle fiber and paper stock met increased demands, and the supply of short-fiber chrysotile was plentiful. The production of anthophyllite in 1928 decreased noticeably, owing in part to the ample supply of short-fiber chrysotile with which it had to compete. The total imports of unmanufactured asbestos into the United States—principally from Canada—were 3 per cent greater in 1928 than in 1927 but 10 per cent less in 1928 than in 1926.

PRODUCTION

The total quantity of asbestos sold by producers in the United States in 1928 was 2,239 short tons, valued at $351,178. These figures represent chrysotile asbestos mined in Arizona and amphibole asbestos mined in Alabama, Georgia, Maryland, and Montana. Corresponding figures for 1927 are 2,981 tons and $336,882. The decrease in the total tonnage in 1928 was due to the decreased production of anthophyllite asbestos in Georgia and Maryland. The production of chrysotile asbestos increased about 24 per cent in quantity over 1927.

Asbestos sold by producers in the United States, 1919–1928, by varieties

Year	Chrysotile		Amphibole		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1919	502	$229, 265	659	$19, 000	1, 161	$248, 265
1920	1, 245	661, 907	403	16, 324	1, 648	678, 231
1921	438	313, 268	393	23, 700	831	336, 968
1922	25	3, 320	42	6, 800	67	10, 120
1923	69	4, 433	158	5, 193	227	9, 626
1924	173	33, 941	127	8, 585	300	42, 526
1925	93	40, 750	1, 165	10, 950	1, 258	51, 700
1926	(1)	(1)	(1)	(1)	1, 358	134, 731
1927	(1)	(1)	(1)	(1)	2, 981	336, 882
1928	(1)	(1)	(1)	(1)	2, 239	351, 178

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[1] Bureau of Mines not at liberty to publish figures.

Following is a list of producers of asbestos in the United States making shipments in 1928.

Producers of asbestos in the United States making shipments in 1928

Name and address	Location of property	Variety of asbestos mined
ALABAMA		
Jere Dennis, Dadeville	13 miles northeast from Dadeville.	Amphibole (anthophyllite).
ARIZONA		
Aileen Asbestos Association, Globe.	10 miles east from Young, Gila County.	Chrysotile (in limestone), cross fiber.
Arizona Asbestos Association (subsidiary of Johns-Manville Corporation), Globe.	Chrysotile, on Ash Creek, Gila County.	Do.
International Asbestos Co., Globe.	45 miles north from Globe, Gila County.	Do.
Regal Asbestos Mines (Inc.), 220 Broadway, New York, N. Y.	Gila County; nearest post office, Rice.	Do.
GEORGIA		
Clayton Paving Co., 615 Independent Life Building, Nashville, Tenn.	Sall Mountain, White County	Amphibole (anthophyllite), mass fiber.
Estate of Abb Landis (Hollywood Asbestos Mines), Hollywood.	½ mile from Hollywood	Do.
MARYLAND		
Powhatan Mining Corporation, Woodlawn, Baltimore.	1 mile northwest from Pylesville	Amphibole (anthophyllite), slip fiber.
MONTANA		
Vermiculite & Asbestos Co., Libby.	7 miles northeast from Libby, Lincoln County.	Amphibole (anthophyllite).

REVIEW BY STATES

Alabama.—Jere Dennis shipped several pounds of anthophyllite (amphibole) in 1928 from a property near Dadeville. The fiber is reported to have passed satisfactory mill tests.

Arizona.—For years Arizona has been the chief source of chrysotile fiber in the United States and in 1928 broke all previous production records. The Arizona Asbestos Association (subsidiary of Johns-Manville Corporation) reported the usual extension in development work at Chrysotile. The report of the Aileen Asbestos Association, whose property is about 10 miles east from Young, stated that the production in 1928 was made jointly by Roger Q. Kyle, of Globe, Ariz., and E. M. Smith, of Downey, Calif. The Regal Asbestos Mines (Inc.) (E. Schaaf-Regelman) reported the usual amount of development work in Gila County (nearest post office, Rice) and also the addition of new mill equipment. The San Carlos Asbestos Mining Co. (Inc.), J. H. Hansen, president, stated that the property at Lakeside was leased but was not operated in 1928. While assessment work was being done on the property of Wightman & Pierce, Globe, a small quantity of asbestos was recovered but was not sold.

Published accounts of activities in the Arizona field record the acquisition of the Bear Canyon property of Lunn & Matthews by Dr. R. V. Mattison, of the firm of Keasbey & Mattison, of Ambler, Pa. It is stated that the property consists of 20 claims 21 miles north from Rice and 3½ miles from the Rice-Springerville highway.

Several new buildings have been constructed on the property, and a new 6-mile road has been completed from the property to the highway.

California.—No sales of asbestos in 1928 were reported from California. The Morgan Mining & Manufacturing Co., of Ogden, Utah, whose property is in Placer County, Calif., near Towle, did assessment work. Norris K. Davis, who in 1927 purchased the property of the San Benito Asbestos Co. (California Asbestos Mining Co.) on Clear Creek, 2½ miles from Hernandez, in San Benito County, reported no new development during 1928. The Sierra Asbestos Co., whose property is near Washington in Nevada County, reported assessment work only.

Georgia.—All the asbestos produced in Georgia is of the anthophyllite variety. Sales of asbestos in Georgia in 1928 were greatly reduced, as both the Hollywood Asbestos Mines, Hollywood, and L. M. Arnold, Statham, ceased operations; the former shipped a small quantity from stock. The Clayton Paving Co. operated on a small scale the Sall Mountain property near Nacoochee, White County.

Maryland.—Asbestos operations in Maryland in 1928 were confined, as usual, to the Powhatan Mining Corporation, whose mine in Harford County, near Pylesville, yields a high-grade slip-fiber anthophyllite used for chemical filtration.

Montana.—The Vermiculite & Asbestos Co. shipped a very small quantity of anthophyllite from its property on Rainey Creek, 7 miles northeast from Libby, Lincoln County.

North Carolina.—The National Asbestos Co., Plumtree, is reported to have sold some asbestos in 1928, but no statement has been obtained from the company as to quantity or value. It is also reported that a plant has been erected in Avery County by the National Asbestos Co. and one in Macon County by a Georgia firm, but no information has been received from the companies.

Oregon.—L. B. Larson, of Baker, reported the retimbering of his 310-foot tunnel and the digging of several open cuts for assessment work and prospecting. It is claimed that a good quality of tremolite is obtained.

Vermont.—Although no commercial asbestos was sold in Vermont in 1928, much interest is centered in the proposed reopening of the property owned by the Vermont Asbestos Corporation in Lamoille County. Hyde Park, 15 miles south of the property, is the nearest railroad station and Eden is the nearest post office. The property was purchased from the Asbestos Corporation of America, which suspended activities in 1923. The mine and mill were rehabilitated and put into operation by the new corporation in December, 1928. The mill is reported to have a capacity of 20 tons of fiber a day; this will be increased to 50 tons a day during 1929 if plans materialize.

PRICES

The prices of Canadian chrysotile (f. o. b. Quebec), which govern domestic prices, are shown in the following table. Comparison with the corresponding prices for 1927 shows that Crude No. 1 was quoted in 1927 at $525 to $575 a ton until December, when it reached a new high level of $650, which it held virtually throughout 1928. In 1928 Crude No. 2 ranged from $375 to $500 a ton, compared with $300 to

$375 a ton in 1927 until December, when the price rose sharply. Crudes Nos. 1 and 2 are the best grades of chrysotile and are always in good demand. Although Canada produces a larger tonnage than any other country in the world, her output of the higher grades, crudes and spinning fibers, is a small part of her total, amounting in 1928 to only about one-sixteenth, whereas the output of Arizona chrysotile is largely high-grade fiber suitable for spinning.

Monthly prices per short ton of Canadian chrysotile asbestos, f. o. b. Quebec, 1927–28

1927

Grade	January	February	March	April	May	June	July	August	September	October	November	December
Crude No. 1	$525	$525	$525	$525	$525	$525	$525	$525	$575	$575	$575	$650
Crude No. 2	300	325	325	325	325	325	325	325	375	375	375	400–500
Spinning fibers	190	200	200	200	200	200	200	200	225	225	225	200–225
Magnesia and compressed sheet fibers	125–150	125–150	125–150	125–165	125–165	125–165	125–165	125–165	150–200	160	160	160–175
Shingle stock	80	80	80	70–80	70–80	70–80	70–80	70–80	60–125	60–125	60–125	75–125
Paper stock	40–45	40–45	40–45	40–45	40–45	40–45	40–45	40–45	40–50	45–50	45–50	45–50
Cement stock	25	25	25	25	25	25	25	25	25	25	25	25
Floats	15	15	15	15	15	15	15	15	15	15	15	15
Short fibers	10–17.50	10–17.50	10–17.50	10–17.50	10–17.50	10–17.50	10–20	10–20	10–20	10–20	10–20	10–20

1928

Grade	January	February	March	April	May	June	July	August	September	October	November	December
Crude No. 1	$650	$650	$650	$650	$600–$650	$600–$650	$600–$650	$600–$650	$600–$650	$600–$650	$600–$650	$600–$650
Crude No. 2	400–500	400–500	400–500	400	375–400	375–400	375–400	375–400	375–400	375–400	375–400	375–400
Spinning fibers	200–225	200–225	200–225	200–225	190–225	190–225	190–225	190–225	190–225	190–225	190–225	190–225
Magnesia and compressed sheet fibers	160–175	160–175	160–175	160–175	160–175	160–175	160–175	160–175	160–175	160–175	160–175	160–175
Shingle stock	75–125	65–115	60–115	90	55–115	55–115	55–115	55–115	55–115	55–115	55–115	55–115
Paper stock	45–50	45–50	45–50	45–50	45–50	45–50	45–50	45–50	45–50	45–50	45–50	45–50
Cement stock	25	25	25	25	25	25	25	25	25	25	25	25
Floats	15	15	15	15	15	15	15	15	15	15	15	15
Short fibers	------------	10–20	10–20	10–20	10–20	10–20	10–20	10–20	10–20	10–20	10–20	10–20

OUTSTANDING EVENTS

A development of unusual interest which may have far-reaching effects on the future of the spinning-fiber industry is the increasing use of molded brake linings on automobiles. It is claimed that the molded type is well adapted for the internal brakes now so widely used. At least 10 makers of cars use molded brake linings on some or all of their models, and 40 out of 84 models at a recent New York automobile show were so equipped. It is estimated that 800,000 cars having this new type of lining are now in service. As brake-band linings constitute by far the largest use for spinning fiber at the present time, asbestos textile manufacturers will view future developments with great interest.

Among new adaptations may be mentioned an asbestos plaster that will improve the acoustic properties of halls and auditoriums. It is also reported that English spinning mills are using asbestos for the manufacture of artificial silk. Some experiments are being conducted in the use of asbestos for dress fabrics. In hat making asbestos cloth has replaced other fabrics for severe service.

The Arizona industry has expanded considerably. Cyprus, Russia, and South Africa have greatly increased their production. In South Africa many additions have been made to plants, new discoveries have been made, and numerous flotations of new companies have been announced.

Many manufacturing companies consolidated in 1928. The Plant Rubber & Asbestos Works, of San Francisco, merged with the Southern Asbestos & Magnesia Co., of Los Angeles; later these plants were purchased by the Paraffine Companies (Inc.). The Celite Product Co., of Los Angeles, purchased the National Magnesia Manufacturing Co., of Redwood City, and later was taken over by the Johns-Manville Corporation. The Certain-teed Products Corporation merged with the Beaver Products Co. (Inc.), and the H. F. Watson Co. merged with the Continental Roofing & Manufacturing Co. and the Ruberoid Co. Mergers were not confined to America. The amalgamation of two large English concerns—Bell's United Asbestos Co. and Turner & Newall (Ltd.)—establishes the latter as the world's largest asbestos manufacturing firm.

IMPORTS AND EXPORTS [1]

A very large percentage of all the asbestos used in the United States is imported; therefore the sources of foreign supply are of unusual importance to American consumers. The following tables show the imports and exports over a number of years, the imports in 1927 and 1928 by last port of shipment and by classes, and the exports in 1927 and 1928 of manufactured asbestos products.

Asbestos (unmanufactured) imported for consumption in the United States, 1919–1928

Year	Short tons	Value	Year	Short tons	Value
1919	135,270	$7,369,685	1924	183,250	$5,602,945
1920	167,558	9,120,253	1925	230,520	7,134,302
1921	72,463	2,948,302	1926	257,621	8,142,505
1922	149,427	5,144,700	1927	223,693	8,150,340
1923	212,420	7,445,143	1928	230,595	9,017,891

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[1] Figures on imports and exports compiled by J. A. Dorsey, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.

In the following table the countries given are merely the countries from which asbestos was last shipped as shown by the invoices or manifests from which the records of imports were compiled. It is probable that British South Africa (Rhodesia and the Union of South Africa) was the actual source of practically all of the imports except those credited to Canada, Italy, and Germany, those from Germany originating chiefly in Russia.

Asbestos (unmanufactured) imported into the United States, 1927–28, by countries and classes

Country	Crude (including blue fiber)		Mill fiber		Stucco and refuse		Total	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1927								
Africa:								
British—Union of South Africa	2,892	$447,414	587	$50,016			3,479	$497,430
Portuguese—Mozambique	2,052	441,803					2,052	441,803
Other	75	15,390					75	15,390
Austria			25	763	1	$14	26	777
Belgium	94	18,795	111	14,786			205	33,581
Canada	5,470	1,331,426	78,640	3,433,099	131,670	1,915,117	215,780	6,679,642
Germany	1,747	429,567	35	912			1,782	430,479
India, British			3	88			3	88
Italy	6	1,209					6	1,209
United Kingdom	217	43,500	68	6,441			285	49,941
	12,553	2,729,104	79,469	3,506,105	131,671	1,915,131	223,693	8,150,340
1928								
Africa:								
British—Union of South Africa	2,989	492,638	230	26,287			3,219	518,925
Portuguese—Mozambique	2,148	594,979			2	50	2,150	595,029
Other	171	39,082					171	39,082
Australia	94	36,911					94	36,911
Austria					29	809	29	809
Belgium	118	14,095	630	84,912			748	99,007
Canada	5,653	1,194,039	88,876	3,970,913	126,810	1,870,022	221,339	7,034,974
France	109	15,885					109	15,885
Germany	2,231	578,905	108	11,606			2,339	590,511
Italy	13	7,387	(1)	69			13	7,456
Malta, Gozo, and Cyprus Islands			1	84			1	84
Netherlands	91	18,038					91	18,038
United Kingdom	273	58,607	19	2,573			292	61,180
	13,890	3,050,566	89,864	4,096,444	126,841	1,870,881	230,595	9,017,891

[1] Less than 1 ton.

Asbestos (unmanufactured) exported from the United States, 1919–1928

Year	Short tons	Value	Year	Short tons	Value
1919	1,119	$157,416	1924	1,270	$93,163
1920	615	141,071	1925	1,109	70,846
1921	520	101,600	1926	1,104	85,922
1922	376	49,939	1927	309	48,774
1923	680	48,525	1928	850	346.632

Manufactured asbestos products exported from the United States, 1927–28, by grades

Grade	1927		1928	
	Quantity	Value	Quantity	Value
Brake and clutch lining ... short tons	292	$379,437	(1)	$1,421,658
Paper, millboard, and roll board ... do	788	116,616	813	132,287
Pipe covering and cement ... do	2,426	275,159	2,461	286,456
Textile yarn and packing ... do	704	780,841	827	924,318
Magnesia and manufactures ... do	2,766	308,539	2,929	354,562
Asbestos roofing ... squares	67,915	509,316	67,143	445,567
Other manufactures, except roofing ... short tons	1,283	317,178	1,447	434,174

[1] 7,749,743 linear feet; weight not recorded.

WORLD PRODUCTION

Canada is the largest producer of asbestos, but a considerable percentage of the production is of the short-fiber grades. Rhodesia is second in importance, followed by the Union of South Africa and Russia. African production increased markedly during 1928, whereas Canadian production fell off slightly. Judging by exports, Russian production is also on the increase.

World production of asbestos, 1924–1928, in metric tons

[Compiled by L. M. Jones, of the Bureau of Mines]

Country [1]	1924	1925	1926	1927	1928
Africa:					
Southern Rhodesia	23,715	31,161	30,249	30,097	36,251
Union of South Africa	6,569	9,224	12,789	20,085	21,821
Argentina [2]	---	---	38	1	(3)
Australia:					
New South Wales	---	---	5	---	---
South Australia	4	---	---	---	---
Western Australia	75	51	107	11	12
Canada	[4] 150,768	[5] 248,136	[5] 253,469	[5] 249,273	[5] 247,690
China [6]	127	216	(3)	(3)	(3)
Cyprus [6]	3,898	3,343	6,433	11,079	11,765
Finland	(3)	1,347	1,674	1,298	1,462
France	882	2,200	660	(3)	(3)
India, British	127	16	59	69	(3)
Italy	2,160	2,105	2,500	3,600	4,800
Japan	621	1,174	(3)	(3)	(3)
Russia [7]	8,456	12,330	18,334	21,156	(3)
United States	272	1,141	1,232	2,704	2,031

[1] In addition to the countries listed, Bolivia, Brazil, and Madagascar are reported to produce small quantities of asbestos. Statistics of production are not available for Bolivia and Brazil, but exports reported are considerably less than a ton. Production in Madagascar is reported as follows: 1927, 23 kilograms; 1928, 108 kilograms.

[2] Railroad shipments.

[3] Data not available.

[4] Exclusive of by-products (fillers and other short fibers, sand, and gravel), the production of which is reported as 54,023 tons.

[5] Exclusive of sand and gravel, the production of which is reported as follows: 1925, 15,300 tons; 1926, 14.217 tons; 1927, 18,398 tons; 1928, 20,672 tons.

[6] Exports.

[7] Year ended Sept. 30.

NOTES ON PRODUCTION IN FOREIGN COUNTRIES

CANADA

Quebec.—Conditions in the Quebec asbestos industry in 1928 almost paralleled those of 1927. The quantity produced again fell off slightly, decreasing about one-half of 1 per cent from 1927, and the value again increased (about 6 per cent)—indicating the gradual upward trend of prices. The average value per short ton of all asbestos shipped was $41.16, compared with $38.65 in 1927. The decrease in 1928 of 1,700 tons, or about 9 per cent, in the production of crudes and spinning fibers, the highest grades of asbestos, only emphasizes the increase in price. The average value of Crude No. 1 increased about $111 per ton during the year.

The following companies were in operation in the Quebec district during 1928: The Asbestos Corporation (Ltd.), operating the King's, Beaver, Vimy Ridge, and Black Lake mines, as well as the mine at East Broughton which was formerly operated by the Asbestos Mines (Ltd.); the Johnson Co., operating at Thetford and Black Lake; the Keasbey & Mattison Co., operating the Bell mine at Thetford; the Quebec Asbestos Corporation at East Broughton; the Canada Asbestos & Chrome Co. at Coleraine; and the Canadian Johns-Manville Corporation at Danville. The Northern Asbestos Co. (Ltd.) has a small plant recovering asbestos short fibers from the tailings of the Beaver mine; this company does not own a mine, but its output is included in the shipping reports.

The press has commented frequently upon Canada's present and future place among the world's producers of asbestos. The extensive deposits in Quebec, the highly efficient methods of mining and milling, and the proximity of the deposits to the great consuming markets apparently insure for Canada a permanent place among the important producers. Nevertheless, Canada must face increasingly keen competition in the market for spinning fiber. Not many years ago Canada dominated this market, but now she produces approximately only one-fourth of the world supply of spinning asbestos. The great bulk of the tonnage produced in Canada—about 93.6 per cent of the total—is of the nonspinning grades, and in this particular field Canada controls the situation and will undoubtedly continue to control it indefinitely. Spinning fibers command a price that will justify their shipment from remote corners of the world, but the low-priced short fibers are so influenced by freight rates that such material from distant sources of supply can not be profitably utilized in the American market, which demands many thousands of tons of this material every year. Canada's position, therefore, seems secure in this field.

An important development in 1928 was the formation of the Asbestos By-Products Corporation, which plans to build a very large factory at Montreal East for the manufacture of brick and hollow tile from asbestos tailings or refuse. An expansion of the industry to embrace the manufacture of water pipes, foundation block, shingles, and wall board is planned.

Production figures for Quebec during 1928 are given in the following table, quoted from a report of the Bureau of Mines, Province of Quebec. The figures vary slightly from those given by the Dominion Bureau of Statistics.

Production of asbestos in the Province of Quebec for 1928, in short tons

Designation of grade	Shipments and sales		Average value per ton	Stocks on hand Dec. 31, 1928	
	Tons	Value		Tons	Value[1]
Crude No. 1	893	$477, 640	$534. 87	98	$52, 417
Crude No. 2	2, 758	818, 173	296. 65	72	21, 359
Crude run of mine	516	65, 869	127. 65		
Spinning fiber	13, 569	2, 017, 884	148. 71	873	129, 824
Shingle fiber	34, 961	2, 580, 160	73. 80	10, 449	771, 136
Mill board and paper fibers	78, 443	3, 038, 227	38. 73	12, 920	500, 392
Fillers, floats, and other short fibers	141, 893	2, 240, 408	15. 79	25, 594	404, 129
Total	273, 033	11, 238, 361	41. 16	50, 006	1, 879, 257
By-products (sand and gravel)	22, 788	13, 469	0. 59		
Total	295, 821	11, 251, 830			

[1] Values calculated at average price of each grade. These figures are given merely as an approximate guide of valuation of stocks on hand.

Quantity of rock mined during the year 1928, 5,159,247 tons.
Quantity of rock milled during the year 1928, 4,109,823 tons.

AFRICA

Rhodesia.—The most important event in the Rhodesian asbestos industry in 1928 was the official opening in May of the Shabani Railway, linking the asbestos mines with the main line at Somabula. Since the handicap of ox-wagon transport has been removed, production has increased markedly; the output in 1928 exceeded that in 1927 by approximately 20 per cent in tonnage and 22 per cent in value and was far in advance of that in any previous year. Asbestos holds second place in the mineral production of Rhodesia and is exceeded only by gold. Now that improved milling and better transportation have been established, Rhodesia may soon be competing with Canada in the better grades of nonspinning fibers, such as paper stock.

The most important producer is the Rhodesian & General Asbestos Corporation operating the Shabani mine in the Bulawayo district and the Gath and King mines in the Victoria district. This company has enjoyed remarkable prosperity, paying dividends amounting to 25 per cent during the financial year to March 31, 1928, as compared with 20 per cent for the preceding year. The Shabani mine, one of the greatest asbestos mines in the world, began operations only 12 years ago; it now employs about 200 Europeans and 4,000 natives, and the monthly output is valued at £70,000 to £80,000. A new mill and a power plant have recently been completed. A water shortage has been overcome by building a 9-mile pipe line through which water may be pumped from the Lundi River. Extensive additions are being made to the productive capacity of the Gath and King mines also. Orders are so far ahead of present production that they must be rationed. Another important Rhodesian producer is the African Asbestos Mining Co. (Ltd.), a subsidiary of Turner & Newall (Ltd.), operating the Nil Desperandum mine which is connected by a 2-mile railway spur with the Shabani Railway; this company also operates the Croft mine at Filabusi. The Rhodesian Chrome & Asbestos Co. (Ltd.) is a small producer owning the following properties: Wynne's asbestos mine in the Bulawayo district, the Boss mine in the Victoria district, and the Ethel mine and the Glen Loch claims in the Lomagundi district. Other producers are as follows: J. S. Hancock, operating the Pangani mine; the United Mining & General Trust, owners of the Norma mine; and the Vukwe Asbestos Syndicate (Ltd.), operating the Biltong and the Slip mines.

The prosperity and expansion of the larger companies has greatly stimulated prospecting and has led to the flotation of many new companies. Important discoveries have been made in the Gwanda, Victoria, and Mashaba districts, and even near Lusaka in Northern Rhodesia.

The entire output of Rhodesia is of the chrysotile variety. Production over a period of years is shown in the following table.

Asbestos produced in Rhodesia, 1914–1928

Year	Short tons	Value	Year	Short tons	Value
1914	487	£8, 612	1922	14, 249	£577, 699
1915	2, 010	32, 190	1923	20, 364	626, 880
1916	6, 157	99, 059	1924	26, 141	603, 423
1917	9, 562	189, 890	1925	34, 349	766, 381
1918	8, 574	158, 684	1926	33, 344	726, 835
1919	9, 799	425, 240	1927	33, 176	794, 215
1920	18, 823	459, 572	1928	39, 960	970, 327
1921	19, 529	795, 698			

Union of South Africa.—Although the Union of South Africa did not exhibit an expansion comparable with that of Rhodesia, the increase in production is noteworthy—nearly 9 per cent in quantity and more than 16 per cent in value over 1927.

The Cape Province produces crocidolite or blue asbestos. The most important operations are those of the Cape Asbestos Co. (Ltd.) in the Prieska and Hay districts. The Dominions Blue Asbestos Corporation, a subsidiary of Turner & Newall (Ltd.), has recently built a mill at Kuruman to treat blue fiber collected from the neighboring workings. The small scattered production units tend to be absorbed more and more by the larger companies.

The production of 66 short tons of blue asbestos in the Transvaal is noteworthy, as blue fiber in the past has been obtained almost exclusively from the Cape Province. The Transvaal is unique, therefore, in that it produces considerable tonnages of three distinct varieties—chrysotile, crocidolite, and amosite. The chief producer of amosite is the Cape Asbestos Co. operating at Penge near the Oliphants River and producing from 350 to 400 tons per month. This company recently acquired the mines of the Malipsdrift Asbestos Co. on the Malips River about 56 miles northwest of Penge. Amosite is used chiefly in England for spinning, for magnesia pipe coverings and for cement. Increasing amounts are used in the United States, chiefly for spinning, although some is employed in magnesia pipe coverings.

An event of great importance to the industry is the construction of an aerial ropeway, 5.9 miles in length, from the New Amianthus mine at Kaapsche Hoop over a 2,000-foot escarpment to a shipping terminal at Elandshoek. This means of transportation will replace the very difficult 18-mile wagon haul to Godwan River station, and it is estimated that the haulage cost will be reduced to about one-eighth of the present cost of 27s. 6d. per ton. At the end of the year more than two-thirds of the towers had been erected and the ropeway probably will be in operation by the middle of 1929. Chrysotile asbestos deposits with an exceptionally high percentage of spinning fiber are operated in this district chiefly by Turner & Newall (Ltd.) and Munnik-Myburgh Asbestos (Ltd.).

A flood of new asbestos companies is indicative of a boom in the industry in South Africa, although probably only a limited number of them are substantial enterprises.

The following table gives the production over a period of nine years.

Asbestos produced in the Union of South Africa, 1920–1928, in short tons

Year	Transvaal	Cape Province	Natal	Total	
				Short tons	Value
1920	3,541	3,526	45	7,112	£114,195
1921	1,593	3,467	62	5,122	103,067
1922	1,392	2,991	6	4,389	81,230
1923	4,076	4,317	----------	8,393	121,453
1924	4,240	3,001	----------	7,241	110,075
1925	7,628	2,540	----------	10,168	152,115
1926	10,104	3,993	----------	14,097	216,466
1927	17,313	4,827	----------	22,140	343,301
1928	18,976	5,078	----------	24,054	399,550

The relative importance of the different varieties of asbestos is shown as follows:

Asbestos produced in the Union of South Africa in 1928, by varieties

	Short tons	Value
Amosite (Transvaal)	6,748	£69,039
Chrysotile (Transvaal)	12,162	214,866
Blue (Transvaal)	66	2,245
Blue (Cape)	5,078	113,400
	24,054	399,550

AUSTRALIA

It is reported that a British company has acquired a chrysotile asbestos property in the Pilba district of Western Australia. The United States imported 94 short tons of crude asbestos from Australia in 1928.

CYPRUS

The remarkable growth that characterized the asbestos industry of Cyprus during recent years was continued, production in 1928 exceeding that in 1927 by 45 per cent. Although the fiber is of the chrysotile variety, none of spinning quality is produced. The mill fiber carefully graded into three classes—standard, shorts, and fines—finds a ready market in Europe. The Cyprus Trading Corporation (Ltd.) has been organized to handle the sales of the Cyprus Asbestos Co. (Ltd.)—the sole producer on the island.

The following table gives production and exports over a period of years.

Asbestos produced in and exported from Cyprus, 1925–1928 [1]

Year	Production (long tons)	Exports	
		Long tons	Value
1925	3,221	3,290	£54,639
1926	6,197	6,331	121,857
1927	11,200	10,904	207,562
1928	16,287	11,579	231,692

[1] Figures supplied by the Cyprus Trading Corporation (Ltd.).

MADAGASCAR

Numerous serpentine deposits occur in southwest Madagascar and many of them exhibit veins of chrysotile. The fiber is usually harsh and lacks flexibility at the surface, but is of better quality at depth. There is no evidence of deposits sufficiently rich or extensive to be of commercial importance.

RUSSIA

The principal asbestos deposits of Russia are near the town of Bazhenovo, in the Urals, about 50 miles north of Sverdlovsk. They furnish about 85 per cent of the total production of the country. It is claimed that the asbestos ore mined in this district runs 22 to 25 per cent fiber, one-third of which is obtained by hand picking. As the factories of the Uralasbest Trust have been reequipped and a new power plant has been erected, increased production is expected. Through the combined influence of several factors, including large known reserves, many reported occurrences, and the need of outside capital, asbestos has been placed on the list of industries open for concession to foreign firms. Germany receives all the Russian exports and reexports part of them to other European countries and to the United States. The large increase in exports indicates that Russia is regaining its pre-war position as an asbestos producer.

Production figures in the following table are as given in the Economic Review of the Soviet Union. These figures differ in some respects from those given in the Annual Report of the Russian Geological Committee and shown in table of world production on page 105.

Asbestos produced in and exported from Russia, 1924–1928

Year ended Sept. 30—	Metric tons as reported		Equivalent in short tons	
	Production	Exports	Production	Exports
1924	7,932	5,634	8,744	6,210
1925	11,494	5,936	12,670	6,543
1926	17,953	7,215	19,790	7,953
1927	21,500	9,946	23,700	10,964
1928	(1)	[2] 11,147	(1)	12,287

[1] Data not available.

[2] Figures for exports in 1928 obtained from Commerce Reports, Apr. 1 1929, p. 45.

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SALT, BROMINE, AND CALCIUM CHLORIDE

By A. T. Coons[1]

SALT

PRODUCTION

The quantity of salt produced for sale or use by operators of salt mines, wells, and ponds in the United States in 1928 was 7 per cent more than in 1927; the total value increased 8 per cent. Sales of rock salt, including pressed blocks from rock salt, increased 3 per cent; sales of evaporated salt, including pressed blocks from evaporated salt, increased 7 per cent; and the salt content of the brine produced and used by producers for the manufacture of chemicals increased 8 per cent. The average value of all salt in 1928 was $3.32 a short ton—4 cents more than in 1927; that of evaporated salt, including pressed blocks from evaporated salt, was $7.33 in both 1928 and 1927; and that of rock salt sold, including pressed blocks from rock salt, was $3.12—15 cents more than in 1927.

In recent years the salt industry has been characterized by keen competition, a tendency to overproduction, and the closing down of small plants or their absorption by larger operators. There were 84 plants reporting operations in 1928 as compared with 87 in 1927.

Salt sold or used by producers in the United States, 1919–1928

Year	Short tons				Value [a]	
	Manufactured (evaporated)	In brine	Rock salt	Total	Total	Average
1919	2, 392, 290	2, 850, 639	1, 639, 973	6, 882, 902	$27, 074, 694	$3. 93
1920	2, 409, 924	2, 819, 916	1, 610, 189	6, 840, 029	29, 894, 075	4. 37
1921	1, 931, 243	1, 577, 335	1, 472, 576	4, 981, 154	24, 557, 966	4. 93
1922	2, 276, 683	2, 569, 042	1, 947, 124	6, 792, 849	27, 464, 838	4. 04
1923	2, 239, 872	2, 787, 239	2, 103, 602	7, 130, 713	27, 795, 941	3. 90
1924	2, 224, 555	2, 513, 853	2, 064, 707	6, 803, 115	25, 747, 048	3. 78
1925	2, 235, 170	2, 819, 690	2, 342, 640	7, 397, 500	26, 162, 361	3. 54
1926	2, 198, 060	3, 037, 820	2, 135, 720	7, 371, 600	25, 055, 012	3. 40
1927	2, 263, 030	3, 161, 800	2, 143, 860	7, 568, 690	24, 817, 962	3. 28
1928	2, 430, 050	3, 426, 870	2, 217, 780	8, 074, 700	26, 772, 568	3. 32

[a] The values are f. o. b. mine or refinery and do not include cost of cooperage or containers.

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[1] Figures on imports and exports compiled by J. A. Dorsey, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.

Salt sold or used by producers in the United States, 1925–1928, by States

State	1925		1926		1927		1928	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
California	292, 480	$1, 420, 924	288, 440	$1, 397, 587	300, 880	$1, 827, 750	383, 730	$2, 292, 296
Kansas	812, 540	2, 494, 423	729, 880	2, 741, 534	794, 780	2, 971, 544	821, 950	3, 573, 982
Louisiana	500, 350	2, 218, 265	520, 400	2, 457, 875	606, 110	2, 167, 220	630, 780	2, 405, 351
Michigan	2, 172, 600	7, 710, 331	2, 260, 320	7, 594, 418	2, 271, 460	7, 551, 552	2, 405, 240	8, 249, 437
New York	2, 053, 970	7, 133, 244	2, 001, 580	6, 564, 829	1, 964, 080	6, 121, 461	2, 085, 230	6, 400, 933
Ohio	1, 173, 590	4, 116, 625	1, 164, 400	3, 209, 473	1, 203, 170	3, 130, 236	1, 308, 110	2, 988, 862
Porto Rico	12, 060	28, 751	10, 480	19, 182	15, 150	28, 920		
Texas	(1)	(1)	(1)	(1)	54, 270	399, 171	(1)	(1)
Utah	88, 150	432, 846	77, 350	422, 317	74, 690	334, 732	85, 800	193, 582
West Virginia	25, 870	180, 053	23, 180	170, 953	22, 600	167, 155	18, 700	149, 421
Undistributed [2]	265, 890	426, 899	295, 570	476, 844	261, 500	118, 221	335, 160	518, 704
	7, 397, 500	26, 162, 361	7, 371, 600	25, 055, 012	7, 568, 690	24, 817, 962	8, 074, 700	26, 772, 568

[1] Included under "Undistributed."

[2] 1925, Idaho, Nevada, New Mexico, Texas, and Virginia; 1926, Idaho, Nevada, New Mexico, Oklahoma, Texas, and Virginia; 1927, Arizona, Nevada, New Mexico, Oklahoma, and Virginia; 1928, Arizona, Nevada, New Mexico, Oklahoma, Texas, and Virginia.

All important producing States showed increases in output in 1928.

Salt sold or used by producers in the United States, 1927–28, by methods of manufacture

Method of manufacture	1927		1928	
	Short tons	Value	Short tons	Value
Evaporated in open pans or grainers	703, 970	$6, 153, 314	710, 400	$6, 314, 997
Evaporated in vacuum pans [1]	1, 097, 390	7, 873, 998	1, 193, 560	8, 791, 138
Solar evaporated	311, 530	1, 308, 693	380, 370	1, 510, 574
Pressed blocks from evaporated salt	150, 140	1, 251, 022	145, 720	1, 205, 794
Rock	2, 109, 440	6, 146, 307	2, 182, 850	6, 630, 201
Pressed blocks from rock salt	34, 420	230, 048	34, 930	293, 626
Salt in brine (sold or used as such)	3, 161, 800	1, 854, 580	3, 426, 870	2, 026, 238
	7, 568, 690	24, 817, 962	8, 074, 700	26, 772, 568

[1] Including salt manufactured by the spray system of cooling.

New York, Louisiana, Kansas, and Michigan produced nearly 99 per cent of the rock salt reported in 1928.

Rock salt sold by producers in the United States, 1919–1928

Year	Short tons	Value	Year	Short tons	Value
1919	1, 639, 973	$6, 224, 920	1924	[1] 2, 064, 707	[1] $7, 501, 419
1920	[1] 1, 610, 189	[1] 7, 048, 315	1925	[1] 2, 342, 640	[1] 7, 444, 799
1921	[1] 1, 472, 576	[1] 6, 693, 923	1926	[1] 2, 135, 720	[1] 7, 234, 757
1922	[1] 1, 947, 124	[1] 7, 489, 644	1927	[1] 2, 143, 860	[1] 6, 376, 355
1923	[1] 2, 103, 602	[1] 7, 843, 419	1928	[1] 2, 217, 780	[1] 6, 923, 827

[1] Includes pressed blocks made of rock salt, as follows: 1920, 15,182 tons, valued at $172,211; 1921, 20,148 tons, valued at $169,244; 1922, 38,593 tons, valued at $245,174; 1923, 38,043 tons, valued at $281,302; 1924, 36,624 tons, valued at $263,260; 1925, 35,730 tons, valued at $206,818; 1926, 28,870 tons, valued at $196,414 1927, 34,420 tons, valued at $230,048; 1928, 34,930 tons, valued at $293,626.

Evaporated salt sold or used by producers in the United States, 1927–28, by States

State	1927		1928	
	Short tons	Value	Short tons	Value
California	284, 520	$1, 762, 330	366, 440	$2, 205, 826
Kansas	272, 680	1, 964, 431	305, 630	2, 447, 439
Michigan	804, 020	6, 366, 279	913, 750	7, 062, 292
New York	415, 330	3, 271, 745	379, 720	3, 322, 717
Ohio	309, 170	2, 236, 236	299, 110	1, 979, 862
Porto Rico	15, 150	28, 920		
Texas	54, 270	399, 171	(1)	(1)
Utah	(1)	(1)	(1)	(1)
West Virginia	22, 600	167, 155	18, 700	149, 421
Undistributed [2]	85, 290	390, 760	146, 700	654, 946
	2, 263, 030	16, 587, 027	2, 430, 050	17, 822, 503

[1] Included under "Undistributed."

[2] 1927, Louisiana, Nevada, New Mexico, Oklahoma, and Utah; 1928, Louisiana, Nevada, New Mexico, Oklahoma, Texas, and Utah.

Sales of pressed blocks from both evaporated salt and rock salt reported by salt producers decreased 2 per cent in 1928. The production of these blocks from both evaporated salt and rock salt, as reported by the original producers of the salt and shown in the following table, does not represent the entire pressed-block industry because some firms that do not produce salt are making pressed blocks from salt bought in the open market. Pressed blocks from evaporated salt are made chiefly by salt producers in Kansas and Michigan but are produced also in Texas, Utah, Ohio, and California. Pressed blocks from rock salt are made by salt producers in Louisiana, Michigan, and New York. In 1928 the average value of pressed blocks from evaporated salt was $8.27 a ton and that of blocks made from rock salt was $8.41.

Pressed salt blocks sold by original producers of the salt in the United States, 1919–1928

Year	Short tons	Value	Year	Short tons	Value
1919	119, 510	$1, 358, 757	1924	172, 344	$1, 322, 744
1920	129, 224	1, 515, 041	1925	171, 210	1, 276, 503
1921	117, 739	1, 275, 483	1926	154, 540	1, 234, 706
1922	172, 682	1, 554, 429	1927	184, 560	1, 481, 070
1923	166, 116	1, 544, 548	1928	180, 650	1, 499, 420

IMPORTS AND EXPORTS

Salt imported for consumption in the United States, 1919–1928

Year	In bags, barrels, and other packages		In bulk		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1919	9, 676	$137, 627	49, 838	$105, 077	59, 514	$242, 704
1920	29, 567	240, 923	108, 087	435, 576	137, 654	676, 499
1921	38, 374	333, 282	54, 721	197, 749	93, 095	531, 031
1922	[1] 24, 392	[1] 216, 718	89, 530	305, 620	113, 922	522, 338
1923	[1] 36, 185	[1] 240, 970	52, 565	142, 288	88, 750	383, 258
1924	[1] 40, 426	[1] 209, 641	48, 512	114, 451	88, 938	324, 092
1925	[1] 26, 973	[1] 188, 912	58, 815	127, 915	85, 788	316, 827
1926	[1] 29, 008	[1] 138, 356	26, 956	63, 887	55, 964	202, 243
1927	[1] 28, 773	[1] 125, 236	16, 195	42, 439	44, 968	167, 675
1928	[1] 18, 315	[1] 87, 654	24, 541	61, 905	42, 856	149, 559

[1] Includes salt imported for curing fish, as follows: 1922, 2,252 short tons, valued at $5,549; 1923, 16,472 tons, $46,260; 1924, 27,096 tons, $61,581; 1925, 17,976 tons, $51,332; 1926, 24,310 tons, $50,915; 1927, 25,048 tons, $55,054; 1928, 14,710 tons, $34,777.

Salt imported into the United States, 1925–1928, by countries

[General imports]

Country	1925		1926		1927		1928	
	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value
North America:								
Canada	3, 744, 003	$20, 680	2, 931, 833	$4, 884	430, 246	$1, 625	1, 332, 557	$5, 470
Mexico	3, 875	31	1, 486, 152	2, 637	20, 000	98	4, 743, 659	12, 940
West Indies—								
British—								
Jamaica	12, 604, 350	19, 080	10, 997, 900	16, 403	10, 616, 050	14, 634	23, 137, 510	25, 914
Other British	43, 797, 963	47, 363	30, 946, 870	37, 145	4, 952, 170	6, 041	15, 911, 627	18, 107
Dominican Republic	209, 437	380			67, 500	163		
French	198, 414	360	112, 240	173	389, 000	944	125, 200	377
Netherland	10, 546, 196	11, 911	5, 040, 610	6, 085	6, 031, 594	9, 541	1, 497, 655	2, 362
Virgin Islands of the United States	4, 000	18						
South America: Peru					1, 036	38		
Europe:								
Belgium	17	2						
France	232, 960	2, 633	2, 505	32				
Germany	25, 013, 932	44, 167	7, 031, 969	12, 697	1, 692, 501	8, 465	2, 909, 598	11, 403
Greece							11, 108	121
Italy					14, 874, 000	12, 068		
Netherlands							828	75
Spain	30, 128, 000	31, 066	44, 127, 543	39, 501	49, 024, 640	49, 666	28, 560, 000	28, 578
Switzerland					22	5		
Turkey in Europe			56, 000	484				
United Kingdom	15, 434, 656	123, 994	9, 379, 063	87, 210	7, 208, 548	64, 241	5, 819, 163	44, 344
Asia: Japan			1, 120	24	1, 070	21		
Africa:								
Algeria and Tunisia	15, 423, 275	10, 459	9, 240, 320	7, 644				
Portuguese			100, 800	90	536, 000	970		
Oceania:								
Australia	2, 240	63						
French	2, 678, 089	7, 576						
	160, 021, 407	319, 783	121, 454, 925	215, 009	95, 844, 377	168, 520	84, 048, 905	149, 691

Salt exported from the United States, 1919–1928

Year	Short tons	Value	Year	Short tons	Value
1919	119, 416	$1, 396, 625	1924	144, 945	$1, 288, 376
1920	139, 272	1, 901, 593	1925	155, 079	1, 219, 935
1921	109, 563	1, 415, 471	1926	158, 908	1, 277, 790
1922	134, 989	1, 429, 172	1927	153, 832	1, 329, 980
1923	125, 529	1, 211, 226	1928	145, 396	1, 185, 682

Salt exported from the United States, 1925–1928, by countries

Country	1925		1926		1927		1928	
	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value
North America:								
Bermuda	237, 183	$3, 034	148, 867	$2, 174	158, 027	$2, 411	100, 460	$1, 935
British Honduras	280, 815	2, 317	416, 170	3, 332	676, 601	4, 363	865, 495	4, 965
Canada	231, 093, 426	672, 285	225, 134, 503	697, 230	219, 434, 815	744, 932	223, 256, 071	736, 007
Central American States—								
Costa Rica	92, 310	1, 124	134, 500	1, 585	147, 060	2, 045	161, 749	1, 912
Guatemala	230, 384	2, 779	292, 907	4, 139	602, 815	4, 618	603, 386	5, 135
Honduras	2, 520, 355	22, 929	2, 231, 638	20, 412	4, 674, 156	33, 025	3, 706, 772	24, 516
Nicaragua	678, 543	9, 185	688, 778	8, 284	1, 112, 967	11, 190	998, 931	10, 298
Panama	1, 686, 112	15, 569	1, 903, 410	17, 188	1, 470, 556	13, 571	1, 631, 501	12, 862
Salvador	102, 846	705	376	19	3, 048	47	548	19
Mexico	11, 480, 952	111, 072	16, 043, 576	126, 619	17, 196, 038	144, 557	11, 785, 593	110, 712
Miquelon, Langley, etc	5, 340	140	3, 080	93	2, 616	67	2, 558	75
Newfoundland and Labrador	171, 854	1, 885	128, 800	575			48, 925	511

Salt exported from the United States, 1925–1928, by countries—Continued

Country	1925		1926		1927		1928	
	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value
North America—Con.								
West Indies—								
British—								
Barbados	680	$11						
Jamaica	268, 808	1, 215	47, 462	$315	67, 997	$537	172	$12
Other British	4, 716	141	24, 639	486	70, 414	737	8, 534	366
Cuba	56, 794, 230	287, 722	64, 815, 515	315, 423	56, 029, 595	280, 566	40, 217, 746	168, 484
Dominican Republic	167, 505	4, 793	34, 756	1, 075	187, 278	1, 731	27, 886	818
French	300	10					600, 000	900
Haiti	18, 358	537	10, 816	419	10, 307	376	12, 235	398
Netherland	7, 029	89	201	5	5, 445	103	15, 815	241
Virgin Islands of the United States	2, 895	90	4, 444	136	27, 393	233	812, 000	742
South America:								
Argentina	47, 350	1, 224	87, 534	1, 537	2, 072	99	133, 761	1, 785
Bolivia					50	4		
Chile	1, 780	66	3, 360	129	2, 448	105	4, 700	163
Colombia	68, 737	1, 002	55, 307	1, 222	139, 746	1, 740	68, 596	1, 225
Ecuador	1, 544	130	25, 896	442	3, 654	566	2, 393	79
Guiana—Surinam (Netherland)					330	14		
Paraguay			2, 425	90	2, 450	89	2, 400	90
Peru	500	14						
Uruguay	500	47						
Venezuela	170	26	145	11	900	16	30, 000	176
Europe:								
Denmark							3, 185	166
France	23, 287	183	27, 000	245	8, 000	72	10, 060	81
Germany	18, 818	145			110, 380	1, 015	92, 215	800
Iceland and Faroe Islands	1, 300	45						
Netherlands					7, 531	27	10, 342	39
Norway					400	21		
Soviet Russia			432	12				
Sweden	11, 000	120						
Turkey in Europe					330	11		
United Kingdom	158, 080	887	82, 512	793	208, 104	1, 228	467, 542	3, 271
Asia:								
Ceylon	3, 086	292	2, 940	272	5, 848	359	2, 024	185
China	56, 124	4, 680	56, 178	3, 774	50, 675	2, 764	151, 991	7, 852
Chosen	3, 882	89	(1)	(1)	(1)	(1)	(1)	(1)
East Indies—								
British—								
India	7, 542	736	7, 594	687	16, 266	710	6, 045	780
Malaya	600	57	2, 158	159	6, 106	375	3, 208	199
Netherland—								
Java and Madura	1, 362	118	3, 278	262	5, 150	206	16, 684	699
Other			100	10	120	14	2, 492	79
Hong Kong	52, 537	2, 429	40, 041	2, 269	33, 742	1, 814	61, 306	2, 423
Indo-China, French					1, 456	70	3, 944	197
Iraq							208	10
Japan	162, 966	735	[1] 76, 555	[1] 467	[1] 431, 042	[1] 1, 920	[1] 398, 046	[1] 3, 860
Kwantung	2, 940	259	3, 520	234	3, 355	248	5, 400	407
Persia					172	11		
Philippine Islands	462, 587	9, 931	338, 026	10, 125	236, 730	7, 289	313, 293	9, 742
Siam	5, 040	500	5, 190	461	4, 270	370	4, 382	400
Soviet Russia	206, 092	1, 059	110, 390	632	101, 500	471	170, 000	1, 242
Syria					4, 520	132		
Other			624	30				
Africa:								
British—								
South (Union of)					324	14		
West					2, 259	40		
Liberia	978	20			123	38	2, 259	38
Morocco							3, 280	44
Portuguese ("Other")	115	7	240	25	120	12		
Oceania:								
British—								
Australia	2, 422, 637	46, 749	4, 365, 861	47, 479	3, 661, 155	53, 315	3, 135, 376	56, 281
New Zealand	302, 793	7, 429	192, 030	3, 621	440, 533	6, 356	403, 462	6, 947
Other British	14, 900	330	56, 850	1, 123	27, 279	528	32, 665	637
French	252, 935	2, 429	205, 502	2, 170	267, 368	2, 808	394, 862	4, 877
Other	21, 936	565						
	310, 158, 759	1, 219, 935	317, 816, 126	1, 277, 790	307, 663, 636	1, 329, 980	290, 792, 498	1, 185, 682

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[1] Chosen included with Japan.

WORLD PRODUCTION

World production of salt, 1923–1927, in metric tons

[Compiled by L. M. Jones, of the Bureau of Mines]

Country [1]	1923	1924	1925	1926	1927
North America:					
Canada	187,773	191,176	216,729	235,938	245,756
Guatemala	(2)	(2)	57	4,805	(2)
Mexico [3]	67,000	67,000	67,000	67,000	67,000
Panama	(2)	(2)	(2)	1,280	1,149
United States—					
Rock salt	1,908,346	1,873,061	2,125,196	1,937,482	1,944,867
Other salt	4,560,494	4,298,589	4,585,668	4,749,886	4,921,297
West Indies—					
British—					
Bahamas [4]	2,723	1,595	1,312	7,476	1,923
Grenada (Windward Islands) [4]	67	54	71	56	------------
Leeward Islands [4]	805	1,207	802	614	1,214
Turks and Caicos Islands [4]	58,992	53,167	63,434	54,824	28,371
Netherland [4]	11,795	8,894	18,377	10,159	8,218
South America:					
Argentina [5]	110,701	122,432	75,351	96,655	153,213
Chile	38,242	36,093	29,334	34,903	71,549
Colombia [3]	29,000	29,000	29,000	29,000	29,000
Ecuador—					
Rock salt	(2)	(2)	(2)	(2)	628
Other salt	(2)	(2)	(2)	(2)	16,100
Peru	26,522	28,974	28,371	30,114	30,172
Venezuela [3]	30,000	30,000	30,000	30,000	30,000
Europe:					
Albania	(2)	(2)	(2)	5,596	6,169
Austria—					
Rock salt	1,520	2,744	2,087	3,227	2,675
Other salt	81,771	108,425	128,720	141,914	145,405
Bulgaria	(2)	37,000	25,000	(2)	(2)
Czechoslovakia	134,080	124,773	76,683	98,105	122,202
France—					
Rock salt and salt from springs	1,188,586	1,317,908	1,458,370	1,643,360	1,336,400
Other salt	337,703	256,943	262,008	467,610	(2)
Germany—					
Rock salt	1,583,978	1,596,416	1,767,282	1,965,847	2,268,807
Other salt	291,518	377,277	456,810	479,547	533,984
Greece	59,908	68,542	79,316	89,726	104,378
Italy—					
Rock salt	52,754	56,896	63,984	67,610	66,850
Other salt	711,892	750,424	851,653	698,642	984,124
Netherlands—Rock salt	26,813	32,054	34,053	34,505	40,596
Poland	467,592	371,182	429,988	457,503	498,435
Portugal [4]	106,280	90,804	33,744	49,404	(2)
Rumania	306,612	302,761	330,356	344,062	328,028
Russia [6]	987,083	1,074,477	1,214,211	1,457,202	[7] 2,425,311
Spain—					
Rock salt	98,619	105,450	106,627	118,581	110,839
Other salt	617,207	862,856	753,514	978,688	868,381
Switzerland	68,026	74,020	75,120	77,267	77,500
United Kingdom—					
Great Britain and Isle of Man—					
Rock salt	38,494	43,076	35,281	35,152	22,809
Other salt	1,860,170	2,016,914	1,912,061	1,708,864	1,985,250
Ireland, Northern—					
Rock salt	11,205	11,235	10,052	6,191	7,262
Other salt	7,297	7,370	7,230	4,960	(2)
Yugoslavia	[3] 46,000	48,864	48,499	52,260	54,765
Asia:					
Ceylon	28,834	9,412	20,588	16,218	26,080
China (including Kwantung)	[3] 3,600,000	[3] 3,600,000	[8] 3,639,000	[3] 3,600,000	[8] 3,600,000
Chosen	40,200	(2)	(2)	(2)	(2)
Cyprus [3]	3,000	3,000	3,000	3,000	3,000
India—					
British (including Aden)—					
Rock salt	121,594	192,274	152,794	149,025	173,489
Other salt	1,688,150	1,457,258	1,163,137	1,516,026	1,637,817
Portuguese [3]	12,000	12,000	12,000	12,000	12,000
Indo-China [4]	11,398	4,251	5,955	20,456	27,701

[1] In addition to the countries listed, salt is produced in Arabia, Bolivia, Brazil, Gold Coast, Kenya Colony, Madagascar, and Southern Rhodesia, but figures of production are not available.

[2] Data not available.

[3] Estimated annual production.

[4] Exports.

[5] Railway shipments.

[6] Year ended Sept. 30.

[7] Russia in Asia included with Russia in Europe.

[8] Figures of production as published by the Geological Survey of China, Special Report No. 2, Peking, 1926.

World production of salt, 1923–1927, in metric tons—Continued

Country	1923	1924	1925	1926	1927
Asia—Continued.					
Japan—					
Japan proper [9]	479,908	637,169	668,682	614,134	619,138
Taiwan	239,200	136,200	138,000	135,232	113,400
Netherland East Indies	150,636	131,860	441,608	381,402	248,295
Palestine	(2)	2,600	5,600	(2)	7,014
Philippine Islands	76,194	28,919	30,683	24,075	66,669
Russia [6]	89,967	93,078	213,195	184,552	(7)
Siam	[10] 32,948	[10] 40,564	126,086	125,670	115,356
Turkey [3]	100,000	100,000	100,000	100,000	100,000
Africa:					
Algeria	25,079	23,541	27,005	43,216	36,936
Belgian Congo [3]	80	80	80	80	80
Egypt [4]	157,242	209,900	211,130	180,468	222,535
Eritrea	[3] 60,000	[3] 60,000	[3] 60,000	65,000	68,000
Ethiopia—Rock salt	(2)	(2)	(2)	(2)	25,000
Mauritania	(2)	(2)	4,500	4,500	4,300
Mauritius [3]	1,500	1,500	1,500	1,500	1,500
Morocco, French	(2)	3,000	3,500	(2)	(2)
Nigeria [3]	400	400	400	400	400
Portuguese West Africa (Angola) [3]	9,000	9,000	9,000	9,000	9,000
Somaliland—					
British [3]	15,000	15,000	15,000	15,000	15,000
French	[3] 15,000	[3] 15,000	[3] 15,000	[3] 15,000	18,444
Southwest African Protectorate—Rock salt	(2)	340	432	363	343
Sudan, Anglo-Egyptian	[11] 15,010	[11] 9,238	[11] 7,020	[11] 9,333	[3] 9,000
Tanganyika Territory	1,918	4,629	4,000	3,155	4,852
Tripolitania [3]	2,000	2,000	2,000	2,000	2,000
Tunisia	72,982	123,606	128,442	132,080	144,788
Uganda	[12] 1,756	(2)	1,399	1,743	(2)
Union of South Africa [13]	62,170	70,369	59,269	80,517	79,400
Oceania:					
Australia—					
South Australia	51,093	63,693	79,507	92,563	80,559
Victoria	[3] 40,000	[3] 40,000	[3] 40,000	[3] 40,000	36,503
Western Australia [3]	8,000	8,000	8,000	8,000	8,000

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[2] Data not available.
[3] Estimated annual production.
[4] Exports.
[6] Year ended Sept. 30.
[7] Russia in Asia included with Russia in Europe.
[9] Year ended Mar. 31 of year following that stated. The figures do not include output from salt beds which, though situated on Government beach lands, have no fixed areas.
[10] Exports for year ended Mar. 31 of year following that stated.
[11] Shipments from Raiwaya field.
[12] Year ended Mar. 31 of year following that stated.
[13] Year ended June 30.

LOCALITIES PRODUCING SALT IN THE UNITED STATES IN 1928

The salt deposits in the United States that furnish salt for commercial purposes are, with the exception of small deposits used for local supply, confined to definite regions in the northeastern, south central, and western parts of the country. Michigan, New York, and Ohio, included in the first group, furnished 72 per cent of the total salt sold or used by producers in both 1928 and 1927. Kansas and Louisiana, in the central belt of States, are the next largest producers and California is chief among the Western States.

The salt is marketed as evaporated salt and as rock salt. Salt brine is drawn from wells by several chemical manufacturers, and the salt content is used by them in their manufacturing processes. Bittern water, or the residue from some of the salt works, is sold to chemical manufacturers for further treatment and for the recovery of bromine and calcium chloride.

To furnish information often requested regarding the operation of salt properties, the producing companies in 1928, the situation of their plants, and the nature of the salt sold or used by them, as reported to the Bureau of Mines, are given by States on the following pages.

ARIZONA

Yavapai County: Camp Verde—Sodium Products Corporation (address, 1120 Pacific Finance Building, Los Angeles, Calif.); rock salt. This salt is mined incidental to the production of natural sodium sulphate and is sold in crude form as cattle salt to local ranchers.

CALIFORNIA

In California salt is obtained from sea water, from salt springs, lakes, etc., and rock salt. The greater part of the production is from the solar evaporation of sea water, especially along the shores of San Francisco Bay in Alameda and San Mateo Counties. Reports were received in 1928 from the following:

Alameda County:
  Alvarado—Leslie-California Salt Co. (address, 155 Montgomery Street, San Francisco); evaporated salt (solar, vacuum pans), pressed blocks from evaporated salt.
  Mount Eden—Oliver Salt Co. (address, 155 Montgomery Street, San Francisco); evaporated salt (open pans or grainers), solar. Plant operated by Leslie-California Salt Co.
  Mount Eden and Newark—Arden Salt Works (address, Standard Oil Building, San Francisco); solar evaporation.
  Newark—Morton Salt Co. (address, 208 West Washington Street, Chicago, Ill.); evaporated salt (solar, vacuum pans), pressed blocks from evaporated salt.
Inyo County: Keeler (Saline Valley)—Sierra Salt Co. (address, 1151 South Broadway, Los Angeles); solar evaporation.
Kern County:
  Saltdale (Ceneda)—Consolidated Salt Co. of California (address, Long Beach). On a playa known as Cane Lake; solar evaporation.
  Saltdale (Toby)—Long Beach Salt Co. (address, Long Beach). On Cane Lake; solar evaporation.
Los Angeles County: Long Beach (Anaheim Road)—Long Beach Salt Co.; solar evaporation.
Modoc County: Cedarville (8 miles southeast)—Surprise Valley Salt Works; solar evaporation.
Monterey County: Moss Landing—Monterey Bay Salt Co.; solar evaporation.
San Bernardino County:
  Amboy (Saltus)—California Rock Salt Co. (address, 2465 Hunter Street, Los Angeles); rock salt, also calcium chloride from Amboy playa.
  ——— Saline Products (Inc.) (address, 2000 Santa Fe Avenue, Los Angeles); solar evaporation, also calcium chloride.
San Diego County: San Diego (south end of San Diego Bay)—Western Salt Co.; solar evaporation.
San Mateo County: Leslie—Leslie-California Salt Co. (address, 155 Montgomery Street, San Francisco); evaporated salt (solar, vacuum pans), pressed blocks from evaporated salt.

IDAHO

Salt has been produced in small quantities from salt springs and rock-salt deposits in southeastern Idaho. The producing plants are small, and operations are irregular. No production was reported in 1928.

KANSAS

In 1928 Kansas again ranked fourth among the salt-producing States. The salt sold in the State is rock salt and evaporated salt made from brines obtained from solution of rock salt. The companies reporting in 1928 were as follows:

Ellsworth County:
  Kanopolis—Crystal Salt Co. (address, Equitable Building, Denver, Colo.); rock salt.
  ——— Independent Salt Co. (address, 33 South Clark Street, Chicago, Ill.); rock salt.
Harper County: Anthony—Western Ice & Utilities Co. (successor to Kansas-Oklahoma Utilities Co.); evaporated salt (open pans or grainers), pressed blocks from evaporated salt.
Reno County:
  Hutchinson—The Barton Salt Co.; evaporated salt (open pans or grainers, vacuum pans), pressed blocks from evaporated salt.
  ——— Carey Salt Co. (east plant); evaporated salt (open pans or grainers, vacuum pans), pressed blocks from evaporated salt.
  ——— ——— (rock salt mine); rock salt, pressed blocks from rock salt.
  ——— Morton Salt Co. (address, 208 West Washington Street, Chicago, Ill.); evaporated salt (open pans or grainers, vacuum pans), pressed blocks from evaporated salt.
Rice County:
  Lyons—American Salt & Coal Co. (address, La Salle Building, Kansas City, Mo.); evaporated salt (open pans or grainers, vacuum pans), pressed blocks from evaporated salt, rock salt, pressed blocks from rock salt.
  ——— Western Salt Co. (address, Manufacturers Exchange, Kansas City, Mo.); evaporated salt (vacuum pans), pressed blocks from evaporated salt, rock salt, pressed blocks from rock salt.
  Sterling—Sterling Salt Co.; evaporated salt (open pans or grainers).

LOUISIANA

Louisiana in 1928 again ranked fifth in the quantity of salt produced. Rock salt and evaporated salt are produced. The firms reporting in 1928 were:

Iberia Parish:
  Avery Island—Avery Rock Salt Mining Co. (address, Scranton, Pa.); rock salt.
  Jefferson Island—Jefferson Island Salt Mining Co. (Inc.) (address, 324 West Main Street, Louisville, Ky.); rock salt, pressed blocks from rock salt.
  Weeks Island—Myles Salt Co. (Ltd.) (address, 1007 Camp Street, New Orleans); rock salt, pressed blocks from rock salt.
St. Martin Parish: Lafayette—Star Salt Corporation; evaporated salt (vacuum pans).

MICHIGAN

Michigan in 1928 again ranked first among the salt-producing States. The output is obtained from both rock salt and natural brine. The large quantity of brine used in the manufacture of chemicals keeps the State in first place, but in actual production of salt as such Michigan ranks second and New York first. In 1928 reports of production were received from the following companies:

Bay County: Bay City—Halverson Lumber & Salt Co.; evaporated salt (grainers).
Manistee County: Manistee—Ruggles & Rademaker; evaporated salt (open pans or grainers, vacuum pans), pressed blocks from evaporated salt.

Mason County: Ludington—Morton Salt Co. (address, 208 West Washington Street, Chicago, Ill.); evaporated salt (open pans or grainers, vacuum pans), pressed blocks from evaporated salt.

Midland County: Midland—The Dow Chemical Co.; evaporated salt (vacuum pans), also bromine, magnesium chloride, and calcium chloride.

Saginaw County:

Carrollton—Mershon, Eddy, Parker Co. (address, Saginaw); evaporated salt (open pans or grainers).

——— Saginaw Salt Products Co. (address, Saginaw); evaporated salt (open pans or grainers), pressed blocks from evaporated salt.

Saginaw—Estate of Edward Germain; evaporated salt (open pans or grainers).

——— Strable Lumber & Salt Co.; evaporated salt (open pans or grainers).

St. Clair County:

Marine City—Michigan Salt Works; evaporated salt (open pans or grainers, vacuum pans), pressed blocks from evaporated salt.

Port Huron—Morton Salt Co. (address, 208 West Washington Street, Chicago, Ill.); evaporated salt (open pans or grainers, vacuum pans), pressed blocks from evaporated salt.

St. Clair—Diamond Crystal Salt Co.; evaporated salt (open pans or grainers, vacuum pans), pressed blocks from evaporated salt.

Wayne County:

Delray—The Solvay Process Co. (address, Syracuse, N. Y.); brine for the manufacture of chemicals.

Detroit—Detroit Rock Salt Co. (address, Scranton, Pa.); rock salt.

——— Mulkey Salt Co.; evaporated salt (open pans or grainers, vacuum pans).

Ecorse—Worcester Salt Co. (address, 71 Murray Street, New York, N. Y.); evaporated salt (open pans or grainers, vacuum pans), pressed blocks from evaporated salt.

Wyandotte—Michigan Alkali Co.; brine for the manufacture of chemicals.

——— Pennsylvania Salt Manufacturing Co. (address, Widener Building, Philadelphia, Pa.); evaporated salt (open pans or grainers), brine for the manufacture of chemicals.

NEVADA

In 1928 small quantities of solar salt were produced at St. Thomas, Clark County, by the Virgin River Salt Co., and near Fallon (Sand Springs), Churchill County, by the C. W. Kinney Salt Co. It is reported that in 1929 salt will be produced by the Independent Salt Co. (Inc.) (address, 6381 Hollywood Boulevard, Los Angeles, Calif.) at St. Thomas, Clark County, and by the Pure Salt Co. (address, Box 861, Reno) at Fallon, Churchill County.

NEW MEXICO

Production of salt in New Mexico in 1928 was reported at Salt Lake, Catron County, by Frank A. Hubbell Co., of Albuquerque, and near Willard, Torrance County, by the New Mexico Salt Co.

NEW YORK

New York in 1928 again ranked second among the salt-producing States; it, however, ranked first in sales of crystallized salt. Both evaporated and rock salt are supplied by producers, but the entire product is from rock salt. Brine for evaporated salt is obtained by dissolving the rock salt with water that is allowed to flow into the beds and is pumped out when saturated. The producing companies in 1928 were as follows:

Genesee County: Le Roy—Le Roy Salt Co.; evaporated salt (open pans or grainers). Plant taken over in May, 1928, by The Watkins Salt Co., Watkins Glen, but not operated by them.

Livingston County:
  Cuylerville (Halite)—Sterling Salt Co. (address, 29 Broadway, New York); rock salt.
  Piffard—Kerr-Remington Salt Co. (Inc.) (address, 800 North Delaware Avenue, Philadelphia, Pa.); evaporated salt (open pans or grainers, vacuum pans). Company succeeded in June, 1928, by the Worcester Salt Co. (address, 71 Murray Street, New York) and plant operated by them thereafter.
  Retsof—Retsof Mining Co. (address, Scranton, Pa.); rock salt.
Onondaga County: Solvay and Tully—The Solvay Process Co. (address, Syracuse); evaporated salt (open pans or grainers), brine for the manufacture of chemicals and refined salt as a by-product.
Schuyler County:
  Watkins Glen—International Salt Co. (address, Scranton, Pa.); evaporated salt (open pans or grainers, vacuum pans).
  ——— The Watkins Salt Co.; evaporated salt (open pans or grainers).
Tompkins County:
  Ithaca (east shore Cayuga Lake)—Kerr-Remington Salt Co. (Inc.) (address, 800 North Delaware Avenue, Philadelphia, Pa.); evaporated salt (open pans or grainers, vacuum pans). Plant taken over in June, 1928, by the Worcester Salt Co. (address, 71 Murray Street, New York) but not operated; being dismantled.
  Ludlowville—International Salt Co. (address, Scranton, Pa.); evaporated salt (open pans or grainers, vacuum pans).
  Myers—Cayuga Rock Salt Co. (Inc.); rock salt.
Wyoming County: Silver Springs—Worcester Salt Co. (address, 71 Murray Street, New York); evaporated salt (open pans or grainers, vacuum pans).

OHIO

Ohio in 1928 again ranked third in the production of salt. The larger part of the output is used in the form of brine for the manufacture of chemicals.

Cuyahoga County: Cleveland—The Union Salt Co.; evaporated salt (open pans or grainers, vacuum pans), pressed blocks from evaporated salt.
Lake County: Painesville—Diamond Alkali Co. (address, 511 Wood Street, Pittsburgh, Pa.); brine for the manufacture of chemicals.
Medina County: Wadsworth—The Wadsworth Salt Co.; evaporated salt. Plant operated short time only and then dismantled.
Meigs County:
  Minersville—Pomeroy Salt Corporation (address, Pomeroy); evaporated salt (open pans or grainers), also bromine and calcium chloride.
  Pomeroy—The Excelsior Salt Works; evaporated salt (open pans or grainers), also bromine and calcium chloride.
Summit County:
  Barberton—Pittsburgh Plate Glass Co.; brine for the manufacture of chemicals.
  Kenmore—The Colonial Salt Co. (address, Akron); evaporated salt (open pans or grainers, vacuum pans), pressed blocks from evaporated salt.
Wayne County: Rittman—The Ohio Salt Co. (address, Wadsworth); evaporated salt (open pans or grainers, vacuum pans), pressed blocks from evaporated salt.

OKLAHOMA

The principal production of salt in Oklahoma is at Sand Springs, Tulsa County, where the Martin Process Co. manufactures salt from brine obtained as a by-product from oil wells by a process in which the brine is cooled by passing through a spray. Calcium chloride is also produced at this plant. Evaporated salt is also taken from playas and lagoons and used locally as cattle salt; in 1928 C. O. Carpenter and Y. L. Stockman each reported sales of small amounts of such salt from near Vinson, Harmon County.

PORTO RICO

A cyclone in Porto Rico in 1928 and much rainy weather interfered with the production of solar salt, and no sales were reported to the Bureau of Mines for 1928.

TEXAS

Salt was produced in Texas in 1928 as follows:

Anderson County: Palestine—Palestine Salt & Coal Co.; evaporated salt (open pans or grainers), pressed blocks from evaporated salt.
Fort Bend County: Hobby—Texas Salt Co. (address, Esperson Building, Houston). Plant in course of construction.
Van Zandt County: Grand Saline—Morton Salt Co. (address, 208 West Washington Street, Chicago, Ill.); evaporated salt (open pans or grainers, vacuum pans), pressed blocks from evaporated salt.

Salt formed by the evaporation of the waters of playas and lagoons is also used locally by cattlemen but there is no record of the quantity so used.

UTAH

Production of salt in Utah in 1928 was reported by the following companies:

Salt Lake County: Saltair—Royal Crystal Salt Co. (address, 133 Regent Street, Salt Lake City); solar evaporation. New refining plant built; put in operation in December, 1928.
Sanpete County: Axtell—Royal Crystal Salt Co. (address, 133 Regent Street, Salt Lake City); rock salt.
Sevier County:
    Redmond—Great Western Salt Co.; rock salt.
    ——— Paulson Bros; rock salt.
Tooele County: Burmester—Morton Salt Co. (address, 208 West Washington Street, Chicago, Ill.); solar evaporation, pressed blocks from evaporated salt.

VIRGINIA

Salt brine is produced in Virginia at Saltville, Smyth County, by the Mathieson Alkali Works (Inc.) for the manufacture of chemicals.

WEST VIRGINIA

The salt made in West Virginia is all obtained from natural brines. In 1928 the operators were as follows:

Kanawha County:
    Malden—J. Q. Dickinson & Co.; evaporated salt (open pans or grainers), also bromine and calcium chloride.
    South Charleston—Westvaco Chlorine Products (Inc.); brine used in the manufacture of chlorine, also produces bromine.
Mason County: Hartford—Liverpool Salt & Coal Co.; evaporated salt (open pans or grainers), also bromine and calcium chloride.

BROMINE

In 1928 the bromine recovered by the producers from natural brine and the bromine content of bitterns used by producers in the manufacture of bromine compounds was 23 per cent more than in 1927. The larger part of the bromine output as reported is not sold as bromine but as potassium and sodium bromide and other salts.

The figures given in the following table include the bromine content of these salts. The plants operated in 1928 were those of the California Chemical Corporation (address, 233 Sansome Street, San Francisco), Chula Vista, Calif.; The Dow Chemical Co., Midland, Mich.; Pomeroy Salt Corporation (address, Pomeroy, Ohio), Minersville, Ohio; The Excelsior Salt Works, Pomeroy, Ohio; J. Q. Dickinson & Co., Malden, W. Va.; Liverpool Salt & Coal Co., Hartford, W. Va.; and Westvaco Chlorine Products (Inc.), South Charleston, W. Va. So far as the Bureau of Mines is informed no bromine was produced directly from sea water in 1928, although experimental work in this direction continued.

Bromine and bromine in compounds sold or used by producers in the United States, 1919–1928

Year	Pounds	Value	Year	Pounds	Value
1919	1,854,971	$1,234,969	1924	2,033,804	$594,685
1920	1,160,584	745,381	1925	1,566,120	488,406
1921	711,953	172,759	1926	1,245,760	426,837
1922	1,005,174	150,668	1927	1,756,310	564,689
1923	842,352	146,176	1928	2,164,000	649,475

The values of bromine reported to the Bureau of Mines by the producers, representing receipts for the year f. o. b. at the plants, averaged 30 cents a pound in 1928, compared with 32 cents in 1927.

According to Chemical and Metallurgical Engineering, the wholesale price per pound of bulk bromine as quoted in the New York market in 1928 was, as in 1927 and 1926, 45 to 47 cents a pound throughout the year.

The following table shows the imports of bromine and bromine compounds into the United States from 1924 to 1928.

Bromine and bromine compounds imported for consumption in the United States, 1924–1928

Product	1924		1925		1926		1927		1928	
	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value
Bromine	37,318	$8,958	8,009	$2,110	37,839	$14,486	--------	--------	--------	--------
Potassium bromide	935,749	124,414	237,231	62,028	70,440	18,549	20,813	$7,075	23,231	$7,918
Sodium bromide	713,659	110,215	208,434	52,230	212,365	73,313	1,102	370	--------	--------
Ethylene dibromide Other bromine compounds	52,408	13,071	117,867	46,784	271,645	102,894	465,048	144,167	283,205 27,730	86,966 2,857

CALCIUM CHLORIDE

The calcium chloride reported in the following table is an original constituent of the natural brine produced in connection with the extraction of salt or salt and bromine from mineral raw materials only. A further large output of calcium chloride made by manufacturing processes used in chemical industries is not reported. The calcium chloride reported includes an output of mixed calcium and magnesium chlorides and other salts. There was an increase of 7 per cent in the quantity of this product sold by the producers in 1928, as compared with 1927, and 1928 was the seventh year of increase. The production here reported for 1928 was by the California Rock Salt Co. (address, 2465 Hunter Street, Los Angeles), Saltus, Calif.; the Saline Products (Inc.) (address, 2000 Santa Fe Avenue, Los Angeles), Amboy, Calif.; The Dow Chemical Co., Midland, Mich.; Pomeroy Salt Corporation (address, Pomeroy, Ohio), Minersville, Ohio; The Excelsior Salt Works, Pomeroy, Ohio; Martin Process Co., Sand Springs, Okla.; J. Q. Dickinson & Co., Malden, W. Va.; and Liverpool Salt & Coal Co., Hartford, W. Va.

Calcium (calcium-magnesium) chloride from natural brines sold by producers in the United States, 1919–1928

Year	Short tons	Value	Year	Short tons	Value
1919	26,123	$321,596	1924	58,791	$1,164,848
1920	27,849	539,471	1925	67,870	1,386,639
1921	23,672	510,723	1926	82,340	1,710,405
1922	33,067	571,326	1927	95,721	1,947,797
1923	44,961	663,384	1928	102,090	1,995,603

Imports of calcium chloride were not separately recorded by the Bureau of Foreign and Domestic Commerce prior to the change in tariff September 22, 1922. The figures for imports since that time are shown in the following table.

Calcium chloride imported for consumption in the United States, September 22, 1922, to December 31, 1928

Year	Short tons	Value	Year	Short tons	Value
1922 (Sept. 22 to Dec. 31)	740	$8,563	1926	7,372	$96,742
1923	3,232	48,527	1927	6,514	85,456
1924	3,996	54,542	1928	9,263	100,223
1925	2,253	37,121			

MAGNESIUM AND ITS COMPOUNDS

By Paul M. Tyler [1]

INTRODUCTION

Magnesite, the normal carbonate of magnesium, and dolomite, or high-magnesium limestone, formerly were the only commercial sources of magnesium products in the United States. For many years Germany was the main source of natural salts, found abundantly in the Stassfurt deposits. During the World War, however, magnesium chloride and sulphate began to be produced as by-products of the treatment of brines in Michigan, and within the last year or two experiments have been made in California to produce the salts from sea water. In 1927 a deposit of brucite (magnesium hydrate) was discovered in Nevada; it may be of commercial importance.

The manufactured compounds considered in this report include the basic or technical carbonate, calcined and dead-burned magnesite, dead-burned dolomite, and precipitated carbonate and sulphate derived from magnesite or dolomite or crude sulphate.

The dolomite considered in this report is that used because of its magnesium content. For many purposes dolomite is an active competitor of magnesite. In the manufacture of carbon dioxide and in the sulphite process of paper manufacture—the main outlets for domestic magnesite previous to 1914—magnesite has been largely displaced by cheaper dolomite or limestone. Especially selected calcined magnesite was formerly employed extensively by an American company in the manufacture of metallic magnesium, but now the metal is made from magnesium chloride both in this country and abroad. In the chemical industry magnesite may displace lime as a neutralizing agent and precipitant in the manufacture of stearin, glycerol, and soap. In the explosives industry it may be used instead of diatomite as a filler for dynamite. It has been used also as a filler in automobile tires. Certain varieties of vitreous porcelain are made from magnesite. As oxychloride cement adheres firmly to wood, its use has been suggested for protecting railway ties. Other uses of magnesite, for many of which dolomite may also be employed, are as follows: Refractory brick, shapes, crucibles, and furnace hearths, for which dead-burned magnesite and dead-burned dolomite are used; oxychloride (Sorel) cement, made from a mixture of caustic calcined magnesite and magnesium chloride; medicinal and toilet preparations, made from magnesite, dolomite, and natural magnesium sulphate; pipe covering (mixed with asbestos), made in this country mainly from dolomite; an absorbent in the manufacture of dynamite; an accelerator in the vulcanization of rubber; fused magnesia for insulation at exceedingly high temperatures; an adulterant of paint; and in many other less important avenues of consumption.

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[1] Unless otherwise stated, the statistics in this report were prepared by A. E. Davis, and the data on imports and exports were compiled from records of the Bureau of Foreign and Domestic Commerce by J. A. Dorsey, both of the Bureau of Mines.

As a "war mineral," dead-burned magnesite assumed importance in connection with its use as lining for open-hearth steel furnaces. Magnesite cements also played an important part in the World War. Gun foundations made one day could be used the next. Big Bertha, the long-range gun that shelled Paris, was said to have been mounted on a base of magnesia cement. The floors of battleships were made almost exclusively of this material.

MAGNESITE

A small amount of magnesite is marketed in the crude condition, but the bulk of it is marketed calcined. For use in refractories it is dead-burned, but for other purposes it is calcined at a considerably lower temperature to retain a small percentage of carbon dioxide in the product. In this latter form the residual magnesia combines readily with water and carbon dioxide in the air (compare quicklime) and with various acids for the manufacture of salts; in this country it is usually known as caustic calcined magnesite.

Formerly great importance was attached to the physical nature of crude magnesite, amorphous material being considered suitable only for making caustic calcined magnesite, and crystalline magnesite being employed exclusively for dead-burned material used in refractories. In later years, however, it has been found possible to employ crystalline magnesite, mined in Washington, for magnesite cements, and the California amorphous material is now being made satisfactorily into high-grade refractories. In general, however, dead-burned magnesite must contain a small amount of iron, and in Washington iron ore is added to produce the desired result. For use in cement, on the other hand, magnesite should be practically free from impurities that would color the product.

DOMESTIC PRODUCTION

In 1928 mines in the United States produced 127,200 short tons of crude magnesite, valued at $1,098,550, an increase of nearly 5 per cent in quantity and of 0.7 per cent in value, as compared with 1927. The value for the total crude magnesite is determined by arbitrary valuations f. o. b. shipping points; these valuations averaged $11 a ton in California and $7.50 a ton in Washington. Of the total output in 1928, 41,300 tons were produced in California, a decrease of more than 2,000 tons compared with 1927, and 85,900 tons in Washington, an increase of slightly more than 8,000 tons. As in 1927, most of the production in Washington in 1928 was sold as dead-burned magnesite; in California, where virtually the entire production has heretofore entered the market as caustic calcined magnesite, dead-burned material constituted approximately one-third of the sales by producers in 1928.

Four producers operated in California in 1928, one each in San Benito, Santa Clara, Stanislaus, and Tulare Counties. All of the output in Washington was from the mines of the Northwest Magnesite

Co., near Chewelah, Stevens County; this company operated two of its six kilns most of the year and two others part of the time.

Domestic magnesite (expressed as equivalent crude) sold or treated in the United States, 1919–1928

Year	California		Washington		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1919	50,020	$504,973	106,206	$743,442	156,226	$1,248,415
1920	81,782	1,083,262	221,985	1,664,888	303,767	2,748,150
1921	47,904	510,177	----------	----------	47,904	510,177
1922	[1] 55,790	[1] 571,745	(1)	(1)	55,790	571,745
1923	73,350	938,600	73,900	165,100	147,250	1,103,700
1924	67,240	901,700	52,860	139,600	120,100	1,041,300
1925	64,600	872,100	56,060	560,600	120,660	1,432,700
1926	53,940	604,130	79,560	596,700	133,500	1,200,830
1927	43,750	507,500	77,740	583,050	121,490	1,090,550
1928	41,300	454,300	85,900	644,250	127,200	1,098,550

[1] Washington included with California. Bureau of Mines not at liberty to publish figures.

Magnesite of domestic origin sold, 1922–1928

Year	Crude			Caustic calcined			Dead-burned		
	Short tons	Value		Short tons	Value		Short tons	Value	
		Total	Average		Total	Average		Total	Average
1922	1,300	$13,330	$10.25	21,990	$813,630	$37.00	2,200	$51,260	$23.30
1923	6,020	78,260	13.00	28,470	1,035,740	36.38	34,410	671,000	19.50
1924	1,570	20,410	13.00	26,520	883,120	33.30	29,830	787,500	26.40
1925	2,090	26,290	12.58	23,900	782,700	32.75	29,110	923,960	31.74
1926	1,540	17,440	11.32	18,580	596,370	32.10	42,540	1,089,680	25.62
1927	1,800	17,130	9.52	13,890	452,810	32.60	40,210	990,300	24.63
1928	620	5,690	9.18	13,310	454,820	34.17	45,230	1,076,310	23.80

CRUDE MAGNESITE

In 1928 the quantity of domestic magnesite sold crude by the producers was 620 short tons, most of which was later calcined at small plants for use as plaster; the average value was $9.18 a ton. A small quantity of crude magnesite was used by makers of high-grade refractory products, and a much smaller quantity of carefully selected magnesite was sold for the manufacture of medicines and chemicals.

CAUSTIC CALCINED MAGNESITE

The domestic caustic calcined magnesite sold in 1928 amounted to 13,310 short tons, slightly less than sales in 1927 and a decrease of 28 per cent as compared with 1926; the average value in 1928 was $34.17 a ton. Most of the output in 1928 came from mines in California. The producers of caustic calcined magnesite were C. S. Maltby, the Red Mountain Magnesite Co., the Sierra Magnesite Co., and the Northwest Magnesite Co.

The consumption of caustic calcined magnesite for stucco continued to decline, although the use for flooring continued good.

The use of magnesia cement is of relatively recent growth. In the United States it was employed extensively for floors in the Panama-

Pacific Exposition. During the World War it was used for flooring in battleships and later began to be employed for floors in Pullman and other railway cars, in hospitals, restaurants, schools, and other public buildings, and in the kitchens and bathrooms of private homes. Its use for outside stucco is a still later development.

The United States Tariff Commission made a survey of the distribution of the caustic magnesite used during the first nine months of 1923. During this period 73.6 per cent of the total consumed was used for stucco, 12.8 per cent for flooring, 6.9 per cent for chemicals, 1.5 per cent in insulation, and 1.2 per cent in the rubber trade; the use of 4 per cent was undetermined.

Subsequently the use of magnesite in stucco increased materially and later declined. New uses that are assuming importance are for floor sleepers and tack strips, replacing wood laid in buildings of concrete construction. Magnesite lumber, shingles, and wall board are also being placed upon the market.

A useful description of the preparation, properties, and uses of plastic magnesia cements has been published by Stewart,[2] and further data are available in an article by Stettbacher,[3] whose observations as to commercial value may be summarized in the statement that from the buyer's point of view the most important features are: (1) Loss during calcination, (2) total MgO content, and (3) residue insoluble in hydrochloric acid. According to Comber,[4] the usefulness of a calcined magnesite depends not so much upon the total content as upon the proportion of the magnesia that is reactive. Actually 90 per cent magnesia may contain a lower percentage of reactive constituent than an 80 per cent product.

Even in the stucco field dolomite is a possible substitute for magnesite. W. J. McCaughey has patented (United States Patent 1634505, July 5, 1927) a process for producing oxychloride cements from magnesian limestone. Substantially all the magnesium carbonate is calcined without decomposing the lime carbonate, which therefore remains practically inert. Additional magnesia and an alkaline earth chloride are later added. According to United States Consul General C. S. Winans,[5] two Czechoslovak engineers claim to have developed a magnesium silicate composition possessing qualities of hardness, strength, and resistance that should make it a valuable substitute for iron and steel in the manufacture of pipes, chemical containers, retorts, and building columns.

Portland cement mixtures have to a very large extent replaced magnesite in outside stucco; with the development of appropriate means of waterproofing, gypsum products likewise afford potential competition. During the last few years the magnesite stucco trade has suffered a severe setback because inferior mixtures have been supplied by several concerns. The rapid deterioration of this improperly prepared material after standing only a few years has injured unjustly the reputation of this type of construction and hastened the substitution of other materials that are cheaper and often easier to apply.

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[2] Stewart, Leroy C., Plastic Magnesia Cements: Ind. and Eng. Chem., vol. 19, October, 1927, p. 1139.

[3] Stettbacher, Alfred, (The Production, Properties, and Experimental Study of Burnt Magnesite): Chem.-Ztg., Bd. 50, 1926, pp. 741–742, 771–774 (reviewed in Chem. Abs., vol. 21, Feb. 10, 1927, p. 477, and Apr. 20, 1927, p. 1334).

[4] Comber, A. W., The Control of Components for Magnesium Oxychloride Cements: Chem. and Ind., vol. 46, July, 1927, pp. 661–663.

[5] Magnesium Silicate Composition for Construction Purposes: U. S. Dept. of Commerce, World Trade Notes on Chemicals and Allied Products, Feb. 6, 1928, p. 2.

A patent (United States Patent 1665072, April 3, 1928) has been issued to W. J. Schenk for forming imitation marble panels with superposed layers of magnesite cement material, upon each of which coloring powder is sprinkled. J. Agerup (British Patent 268989, May 17, 1926) makes cement with anhydrous magnesium chloride, so that only water needs to be added. Backhouse and Oliver have been issued a patent in Great Britain for making bricks from a mixture containing 5 per cent MgO, 2½ per cent $MgCl_2$, and 92½ per cent sand, clinker, ashes, or slate, with or without 1 per cent of locust (carob) bean dust. Another British patent (No. 269578, April 16, 1926), recently announced in this country, provides for waterproofing magnesia cements by means of a lead soap, casein, or other suitable colloid.

DEAD-BURNED MAGNESITE

The domestic dead-burned magnesite sold in the United States in 1928 amounted to 45,230 short tons, an increase of 12 per cent as compared with 1927; the average value was $23.80 a ton, 83 cents less than in 1927. By far the bulk of the dead-burned output in 1928 was produced in Washington, but the production of sintered magnesite in California continued to grow. Much of the California product was artificial periclase for use as a high-grade refractory. An interesting development was the working out of methods by Schuette[6] for producing thick-walled magnesia crucibles. Various patents have been issued during the last few years for producing magnesite brick and sundry molded articles. In one process magnesite is held together by linseed oil. Another plan[7] is lightly to calcine highly pure magnesite, grind it fine with a quantity of raw magnesite, briquet the mixture, sinter it above 1,600°, break it into granules, and finally mix these granules with ground dead-burned magnesite and form the mixture into bricks that are fired at 1,400° to 1,500°. Schlotterer and Youngman have been issued a patent (United States Patent 1643181, September 20, 1927) for forming unburned refractory brick from mixtures of dead-burned magnesite and powdered sodium silicate (5 to 10 per cent). The mixture is moistened, formed, and dried carefully and slowly at slightly above ordinary temperatures. Metal-cased brick are formed by ramming magnesite into short lengths of old boiler tubes.

MARKET AND PRICES

The world demand for magnesite is small compared to the potential supply. For dead-burned magnesite the total requirements of all countries amount to about 300,000 tons annually, and of this Austria alone could furnish fully 70 per cent. The European market is stabilized largely through the efforts of a cartel comprising all of the four (formerly six) Austrian producing companies, four producers in Czechoslovakia, and several German and at least one English brick factory. The scope of this control, however, is limited by the existence of extensive deposits elsewhere, which may become productive. Greek magnesite was used extensively as a refractory during the war; Russian supplies, now increasing rapidly, may prove a factor. Under these

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Schuette, C. N., The Production of Magnesia and Silica Crucibles in the Induction Furnace: Repts. of Investigations, Serial 2896, Bureau of Mines, October, 1928.

[7] Schaefer, J., Canadian Patent 263549, Oct. 22, 1925.

circumstances the cartel has found it necessary to adjust its prices to suit the varying conditions encountered in different centers of consumption. Early in 1928, for example, Austrian dead-burned magnesite was quoted, f. o. b. plant, at $18.50 a metric ton for local consumption, but for export to the United States it was sold for $14.38 ($24.61 a ton c. i. f. Chester, Pa.). Between these extremes were the export quotations of $16.65 for English consumption and $16.83 for shipments to Germany or Spain. Similarly, the price of magnesite brick was $43 a metric ton for the home market as against $31.63 ($44.08 c. i. f. Chester, Pa.) for American consumption.[8]

In the American market domestic producers are protected by a tariff. At the opening of 1928 the Engineering and Mining Journal was quoting caustic calcined magnesite at $40 a short ton for grade A, $38 for grade B, and $14 for crude magnesite, all f. o. b. California mines. In April grade A was advanced to $42, grade B was shaded to $37.50, and the price of crude was dropped to $11. As the year progressed the quotations reflected a somewhat stronger tone for caustic calcined, but there was a contrary trend for dead-burned magnesite, which was quoted in January at $30 to $32 a ton, f. o. b. Chewelah, Wash., but soon dropped to $29 and at the end of the year to $22 a ton. At the beginning of 1929 the quotations, all per short ton of 2,000 pounds, were as follows:

> *California* grade A calcined, 80 per cent through 200 mesh, $43; grade B, $40; dead-burned, $29; and crude, $11—all f. o. b. mines. High purity periclase was quoted, f. o. b. eastern seaboard, at $40 per net ton.
>
> *Washington* dead-burned magnesite, $22 @ $24, f. o. b. Chewelah.

In their statements to the Bureau of Mines California producers reported sales in 1928 of crude at $11 a ton, of caustic lumps at $31 to $40 a ton (depending upon location), and of dead-burned (except periclase) at $29 a ton, f. o. b. mines.

The quotations for calcined powdered magnesite delivered at United Kingdom ports dropped in August, 1928, from £7 15s. to £7 7s. 6d. a long ton. The latter price, which was continued throughout the remainder of the year, was equivalent (exchange at par) to approximately $32 a short ton.

Average value per short ton of domestic and imported magnesite, 1924–1928

Year	Domestic[a]			Imported[b]		
	Crude	Caustic calcined	Dead-burned	Crude	Calcined	
					Caustic calcined	Dead-burned
1924	$13.00	$33.30	$26.40	$14.17	$23.44	$16.32
1925	12.58	32.75	31.74	13.10	24.29	14.54
1926	11.32	32.10	25.62	10.78	22.26	14.64
1927	9.52	32.60	24.63	10.02	23.49	14.59
1928	9.18	34.17	23.80	9.02	24.26	14.61

[a] Value f. o. b. mine shipping point. [b] Declared value.

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[8] Prices furnished by Consul John P. Hurley, Vienna.

IMPORTS

Previous to about 1915 imports furnished the bulk of the domestic supply of magnesite, and in 1922 they contributed approximately 80 per cent of the total. Since the tariff act of 1922 became operative, however, foreign purchases have dropped to between 50 and 60 per cent of the magnesite used in the United States. Imports of crude magnesite, formerly quite substantial, have been reduced to almost negligible proportions. In 1928, following an increase in the duty as a result of the presidential proclamation effective December 10, 1927, imports of caustic calcined magnesite dropped off much more than domestic sales; only 29 per cent of the apparent supply was imported in that year as compared with 41 per cent in 1927. Imports of dead-burned magnesite, on the other hand, increased somewhat more than domestic production and formed about 55 per cent of the apparent supply in both 1928 and 1927.

In former years Austria furnished the bulk of the dead-burned magnesite, and Greece supplied the plastic trade. In 1924 imports of lump caustic from India became a factor in the building material field. In 1928 Czechoslovakia furnished approximately 38 per cent of the imports of dead-burned magnesite, as compared with 19 per cent in 1927 and only 2 per cent in 1926.

Magnesite imported into the United States, 1924–1928, by countries, in short tons

[General imports]

Country	1924	1925	1926	1927	1928
Africa, British South	(1)	34			
Austria	156		7,028	39,752	34,997
Belgium	54	433	303	187	25
Canada	124	95	41	213	45
Czechoslovakia		100	1,688	9,666	21,876
Denmark			360		
France	28				
Germany	206	275	169	74	358
Greece	110	408	594	840	760
India, British	8,011	9,933	9,223	5,795	3,426
Italy	54,619	51,521	68,269	317	
Kwantung			25		
Netherlands	5,348	4,752	3,944	3,167	1,959
Norway		23			
Poland and Danzig				(2)	
United Kingdom:					
England	548	1,543	902	213	56
Scotland	1,202				
	70,406	69,117	92,546	60,224	63,502

[1] 595 pounds.

[2] 1,100 pounds.

Magnesite imported into the United States, 1927–28

[General imports]

Country	Crude		Caustic calcined		Dead-burned and grain (not suitable for manufacture into oxychloride cements)	
	Pounds	Value	Pounds	Value	Pounds	Value
1927						
Austria			63,115	$867	79,440,280	$575,633
Belgium			373,534	6,092		
Canada	266	$3	184,500	2,667	240,800	2,914
Czechoslovakia					19,331,727	144,094
Germany			44,754	1,822	103,422	1,189
Greece	1,568,000	7,113	111,536	1,220		
India, British	140,068	1,369	11,449,402	102,316		
Italy			4,480	45	629,003	4,051
Netherlands	4,586	89	6,330,581	99,600		
Poland and Danzig			1,100	24		
United Kingdom			427,051	8,375		
	1,712,920	8,574	18,990,053	223,028	99,745,232	727,881
1928						
Austria					69,993,002	504,100
Belgium			49,221	840		
Canada					90,800	1,135
Czechoslovakia					43,752,554	323,374
Germany			22,045	682	693,574	7,777
Greece	1,520,000	6,088				
India, British	158,688	1,329	6,693,220	69,340		
Netherlands			3,918,773	57,222		
United Kingdom	4,658	176	106,400	2,806		
	1,683,346	7,593	10,789,659	130,890	114,529,930	836,386

Magnesite imported for consumption in the United States, 1919–1928

Year	Crude		Calcined	
	Short tons	Value	Short tons	Value
1919	6,381	$103,311	9,471	$270,721
1920	33,550	406,204	14,780	373,165
1921	51,993	525,452	6,788	250,932
1922	73,331	976,283	72,265	1,267,622
1923	5,182	44,081	72,955	1,022,968
1924	6	85	64,785	1,172,403
1925	487	6,382	68,395	1,160,830
1926	608	6,555	90,293	1,438,765
1927	856	8,574	59,261	946,361
1928	762	6,264	62,481	966,183

EXPORTS

Exports of magnesite are small. An examination of producers' and dealers' records by the United States Tariff Commission showed that during six months of 1923–24 less than 100 tons of magnesite in all forms was exported. Official statistics are not available. A few thousand tons of magnesia products, including pipe and boiler coverings, are exported annually, and small quantities of magnesite brick are shipped to Canada and Mexico.

ANNUAL SUPPLY

The annual additions to supply of magnesite may be considered as domestic sales plus imports, as exports are negligible. Although such figures take no account of stocks at grinding mills and in consumers' hands, they do furnish a fairly accurate index of consumption.

Magnesite supply in the United States, 1923–1928, in short tons

Year	Crude			Caustic calcined			Dead-burned		
	Domestic (sales)	Imports for consumption	Total new supply	Domestic (sales)	Imports for consumption	Total new supply	Domestic (sales)	Imports for consumption	Total new supply
1923	6, 020	5, 182	11, 202	28, 470	11, 229	39, 699	34, 410	61, 726	96, 136
1924	1, 570	6	1, 576	26, 520	16, 134	42, 654	29, 830	48, 651	78, 481
1925	2, 090	487	2, 577	23, 900	17, 075	40, 975	29, 110	51, 320	80, 430
1926	1, 540	608	2, 148	18, 580	14, 758	33, 338	42, 540	75, 535	118, 075
1927	1, 800	856	2, 656	13, 890	9, 568	23, 458	40, 210	49, 693	89, 903
1928	620	762	1, 382	13, 310	5, 474	18, 784	45, 230	57, 007	102, 237

DOMESTIC INDUSTRY

California.—The Sampson Magnesite Co., owner of the Sampson Peak mine in San Benito County, which began mining and dead-burning in 1927, made its first shipments in 1928; operations were handicapped by bad roads between the mine and Mendota, the railroad point. As in former years, C. S. Maltby, operating mines in Santa Clara County, was the largest producer in the State, producing crude magnesite and also both dead-burned and caustic calcined magnesite. The Sierra Magnesite Co. was the only producer in Tulare County and the second largest operator in the State; its mines are at Magnesite, 12 miles east of Porterville, and its calcining plant is at Porterville, where it produces both caustic calcined and a special grade of dead-burned magnesite in two kilns. The Red Mountain Magnesite Co. operated its mine in Stanislaus County, west of Patterson, and made sales of caustic calcined magnesite for magnesia heat insulation and for flooring and stucco; it has one upright kiln. Other mines and prospects in the above-mentioned counties and in Alameda, Fresno, Monterey, Placer, San Bernardino, Sonoma, and Tuolumne Counties reported no production in 1928.

Nevada.—During 1927 a deposit of brucite (magnesium hydrate) of great purity was discovered on the west slope of Paradise Mountains, in Nye County, 30 miles north of Luning. The owner, H. E. Springer, of Mina, states that 2,000,000 tons has been exposed, and that the deposit, which occurs on a contact of granite with dolomite, has not yet been bottomed. In Washington brucite occurs in considerable quantity along a fault vein in one of the large magnesite deposits but is described as "useless" for calcining purposes on account of the large amount of water held in combination.[9] Tests made upon the Nevada brucite, however, are said to have demonstrated that the material can be used commercially. Transportation difficulties are not very serious, and, as the deposits are exceedingly large, this occurrence is likely to prove an important factor in the domestic situation.

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[9] Siegfus, S. S., Some Geological Features of the Washington Deposits: Eng. and Min. Jour., vol. 124, Nov. 26, 1927, pp. 853–857.

Washington.—The Northwest Magnesite Co., operating the Finch mine, near Chewelah, Stevens County, the only producer in the State in 1928, marketed a small tonnage of caustic calcined magnesite in addition to its shipments of dead-burned magnesite to an eastern refractory company. Two of its six kilns were operated fairly continuously, and two others were operated part of the year.

WORLD PRODUCTION

World production of magnesite, 1923–1927, by countries, in metric tons [1]

[Compiled by L. M. Jones, of the Bureau of Mines]

Country	1923	1924	1925	1926	1927
Australia:					
New South Wales	6,228	12,697	14,237	10,428	10,178
Queensland	----------	151	271	----------	----------
South Australia	168	131	357	230	335
Victoria	76	77	92	96	73
Western Australia	[2] 2	----------	----------	----------	----------
Austria	[3] 180,292	[3] 156,868	290,000	237,000	356,000
Canada	12,079	9,512	3,827	11,429	18,523
Cyprus [2]	284	224	----------	83	16
Czechoslovakia [4]	64,030	60,044	69,532	83,135	84,563
Greece	62,552	66,727	90,828	95,638	84,484
India, British	19,748	24,854	30,095	30,950	19,953
Italy	12,474	13,436	14,146	19,842	16,304
Norway	2,359	1,976	1,699	715	1,090
Russia [5]	18,445	33,214	75,840	103,017	106,583
Union of South Africa	1,387	2,001	1,823	1,884	1,839
United States (sold or treated)	133,582	108,952	109,460	121,109	110,213
Yugoslavia	----------	----------	----------	----------	1,680

[1] Unless otherwise stated, the quantities in this table represent crude magnesite mined.

[2] Exports.

[3] Data relate to exports of crude and sintered magnesite, the sintered being reduced to crude on the basis of 2.1 tons of crude to 1 ton sintered. In addition, the following quantities of caustic magnesia were exported: 1923, 5,341 tons; 1924, 6,431 tons.

[4] Exports, less imports, of crude and sintered magnesite, the sintered being reduced to crude on the basis of 2.1 tons crude to 1 ton sintered.

[5] Year ended Sept. 30.

FOREIGN INDUSTRY

Formerly the bulk of the world's magnesite output was produced in Austria-Hungary and Greece, but the list of producing countries has been enlarged greatly within the last 15 years. Of the pre-war output of Austria-Hungary about 75 per cent was produced in Austria and 25 per cent in what is now Czechoslovakia. These Succession States and Greece, although they still furnish a large quantity, do not contribute so large a tonnage as they did in 1913, and, since world demands are now much greater, their output is relatively less important. Other countries, as has the United States, have increased production, and several altogether new fields have been opened up. Much of this new development has been in connection with the rapid growth in the manufacture and use of caustic calcined material for construction purposes. Magnesite is not an unusual mineral. Deposits of considerable size are known to exist in many parts of the world, and production from both new and old deposits could easily and rapidly be increased several fold, provided the larger output could be sold at even a small margin above producing costs.

Australia.—Magnesite has been reported in various parts of Australia. In New South Wales production increased rather rapidly from an almost negligible quantity in 1913 to a maximum of 14,237 metric tons in 1925. Huge deposits of excellent material, exceptionally free from impurities, have been reported at Kunwarara, in Queensland, and a company may be formed to work this area.[10]

Austria.—The magnesite industry in Austria is now concentrated in four large companies, all Austrian concerns, although one of them, the Austro-American Magnesite Co. of Radenthein (Carinthia), is controlled by American capital. The two leading Austrian companies are the Veitscher Magnesitwerke A. G. and the Oesterreichisch-Amerikanische Magnesit A. G. (Austro-American Magnesite Co.); they furnish almost 90 per cent of the total output of the country.

The industry employs about 2,500 persons. The miners belong to the same union as the coal miners and receive the same wages, whereas employees at the kilns are in the same class as are the steel and metal workers. Wages are fixed by collective agreement. In 1928 miners were getting 8 schillings ($1.14) for an 8-hour shift, and burners were receiving 10 schillings ($1.43) for the same number of hours.

The productive deposits occur mainly in a long narrow belt extending southwest from Vienna. Near the village of Gross Veitsch the magnesite forms two hills 3,000 feet in height; at Radenthein the deposit rises about 5,000 feet above the lowest quarry floor. The Veitsch mines are 60 miles from the capital; Oberdorf and Kraubath are 18 and 33 miles, respectively, beyond the Veitsch mines; and Radenthein is 50 or 75 miles still farther to the southwest and more or less in the same general line.

In 1928 there were 46 pit kilns and 3 rotary kilns, in addition to 11 brick ovens. This equipment was, however, being operated at only 45 to 65 per cent of its full capacity. The consumption of electric power, for example, in 1927 was 9,200 hp., as compared with a maximum consumption of 16,700 hp.

In the pit kilns producer gas made from bituminous coal is used, but in the rotary kilns lignite may be employed in the proportion of about three parts of lignite to one part of coal dust. The bituminous coal comes from Upper Silesia, but the lignite is of domestic origin. The ratio of fuel to raw magnesite is about 32 per cent in the pit kilns.

From 80 to 90 per cent of the Austrian output is from crystalline deposits; this magnesite, as it contains 3 to 5 per cent of iron oxide, sinters readily. The average analysis of the dead-burned material has been 88 per cent of magnesia, 2.5 per cent of lime, 2 per cent of silica, 4 per cent of iron oxide, 0.6 per cent of alumina, and 2.9 per cent undetermined. Amorphous magnesite (some of which is sold crude, although most of it is caustic calcined) analyzes, after calcination, 97.6 per cent of magnesia, 0.9 per cent of lime, 1 per cent of silica, and 0.5 per cent of iron oxide.

Average analyses of calcined products

	Crystalline (dead-burned)	Amorphous (caustic)
SiO_2	2	1
Fe_2O_3	4	.5
Al_2O_3	.6	----------
CaO	2.5	.9
MgO	88	97.6
Undetermined	2.9	----------
	100.0	100.0

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[10] Mining Magazine (London), Magnesite in Queensland: Vol. 38, No. 4, April, 1928, pp. 224–225.

The average cost of production of dead-burned magnesite is unofficially stated as $12 a metric ton. Sales commissions add 5 per cent on the realized value. The cost of producing raw magnesite is given as $2.50 a metric ton.

Austrian production from 1925 to 1928 was as follows:

Magnesite produced in Austria, 1925–1928, in metric tons[1]

Year	Raw	Calcined			
		Caustic calcined	Dead-burned		
			Brick	Other	Total
1925	290,000	11,000	40,000	56,000	96,000
1926	237,000	9,000	34,000	62,000	96,000
1927	356,000	26,000	46,000	79,000	125,000
1928 [2]	310,000	38,000	42,000	69,462	111,462

[1] Compiled from reports of Consul John P. Hurley, Vienna.
[2] Estimated.

Vice Consul Perkins[11] accounts for the decrease in Austrian production in 1928, as follows:

> Since the industry is dependent on export sales for the disposition of more than 90 per cent of its total production, the reason for practically any development, in 1928 as in other years, must be sought outside of the country.
>
> During the first half of the year, in particular, sales of dead-burnt magnesite were curtailed on the British and German markets by a slackening of smelting activity in these countries, while in November and the first half of December exports to Germany were affected unfavorably by the lockout in the German iron and steel industry. The marked increase in foreign sales of caustic calcined magnesite and the upward trend of domestic consumption were not sufficient to offset the decline in earnings resulting from a poor year for dead-burnt magnesite. * * *.
>
> The total Austrian output of raw magnesite, both crystalline and amorphous, during 1928 is estimated at 310,000 tons, a decline of 13 per cent from the 356,000 tons mined in 1927. * * *.
>
> Since dead-burnt magnesite was produced in 1928 by the two leading companies only, their combined output of this variety (111,462 tons) represents the exact Austrian production for the year. This amount shows a decrease of 11 per cent from the 125,000 tons burned in 1927. * * *.
>
> Caustic calcined magnesite is the only variety that increased its production in 1928. The year's output is estimated at 38,000 tons, an increase of 46 per cent over that for 1927. No caustic calcined magnesite was produced by the Veitsch company in 1928, and only a few hundred tons was produced during 1927.
>
> The activities of Austrian magnesite brick factories also showed a downward trend during 1928, production totaling about 42,000 tons, compared with 46,000 for the preceding year. The dead-burnt magnesite, which served as material for these bricks, is included.

British India.—A little magnesite was produced in British India before the World War, and for a number of years after the war the output averaged somewhat less than 20,000 tons annually. A rapid expansion began in 1924 and culminated in 1926 with a record production of 30,461 long tons, valued at £26,444. In 1927, however, there was a decline to 19,638 tons, valued at £17,115.[12] Ordinarily more than 90 per cent of the output has come from the Chalk Hills at Salem, in the Madras Presidency, in South India, where the deposits have been worked for 30 years and where 2,000 persons were employed in and about the quarries in 1927. Recently an increasing quantity has been reported from the Mysore State. Indian magnesite is calcined locally, and all but a small percentage (used for home consumption) is shipped in lump form to grinding plants in Belgium, France, Great Britain, the United States, and other countries, where it is powdered for use in oxychloride cement.

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[11] Perkins, G. Warwick, Magnesite Production and Trade in Austria: Commerce Repts., Apr. 8, 1929, pp. 98–99.

[12] Fermor, L. L., Magnesite: Records Geol. Surv. Ind., vol. 61, pt. 3, 1928, p. 226.

Canada.—Practically all the magnesite of commercial value mined in Canada is in the townships of Grenville and Harrington, in Argenteuil County, Quebec, although fairly large deposits of hydromagnesite occur in several parts of British Columbia. Hydromagnesite, although somewhat similar in composition to hard-rock magnesite, is powdery in form and requires a different method of treatment to prepare it for the market.

W. P. Boshart found magnesite float and later located the mineral in place in Quebec in 1900,[13] but no one would buy the material at a profitable price. In 1907 T. J. Watters organized the Canadian Magnesite Co. to operate lot 18, range 11, of Grenville Township. This company bought also the mining rights on lot 15, range 9, from Donald McPhee, on whose farm Boshart had first found magnesite. A 10-ton keystone kiln was erected, and the crude rock was calcined to reduce the cost of hauling to Calumet, 9 miles away. Operations were continued intermittently by this company until 1914, when it was taken over by the North American Magnesite Co. In the following year S. Melkman, of Montreal, organized the Scottish Canadian Magnesite Co., which began work in August, 1915, on lot 15, ranges 10 and 11, Grenville Township, and constructed a narrow-gage railroad to connect with the Canadian Pacific North Shore, Ottawa-Montreal line, a short distance east of Grenville station, some 11 miles from its property. In 1916 the International Magnesite Co. was organized and started work on lot 13, range 1, of Harrington Township.

During the World War Canadian magnesite found a good market for refractory use in the United States but after the war, during the reconstruction period, renewed competition from Austria and Greece and the duty placed on American imports by the tariff cut heavily into this trade, and the Quebec companies were driven to research in the building field. Experiments conducted by the Scottish Canadian Magnesite Co., in cooperation with the Dominion Bureau of Research, eventually resulted in perfecting a method of neutralizing the lime—which constitutes 7 to 10 per cent of the Canadian mineral—so as to permit the manufacture of Sorel cement products.

In 1928 the industry showed an upward trend and the production of calcined and dead-burned magnesite was 13,195 short tons, valued at $346,990, as compared with 7,337 tons, valued at $230,309, in 1927. The following table showing production, imports, and exports for 1927 and 1928 indicates an increase of $116,681 in the value of the output in 1928 over that in 1927, an increase of $55,624 in the value of the imports, and a decrease of $3,386 in the value of the exports.

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[13] Lanigan, A. R., The Magnesite Industry of the Province of Quebec: Canadian Min. Jour., vol. 50, Gardenvale, Quebec, Apr. 5, 1929, pp. 306–307.

Magnesite produced in, imported into, and exported from Canada, 1927–28[1]

	1927		1928	
	Short tons	Value	Short tons	Value
Production:				
Calcined	7,337	$230,309	13,195	$346,990
Clinkered				
Imports:				
Magnesia pipe covering		157,982		187,381
Magnesite	166	5,805	220	9,543
Magnesite firebrick		118,457		140,944
Exports: Magnesite, calcined	1,953	47,487	1,837	44,101

[1] Min. Prod. of Canada (Prelim. Rept.), 1928, Dominion Bur. of Statistics, p. 28.

The preliminary report of the Dominion Bureau of Statistics on mineral production in 1928 states, with respect to natural magnesium sulphate, that no activities have been reported in the industry since 1923. In that year 121 short tons of refined magnesium sulphate was shipped from a deposit near Ashcroft, British Columbia. The importation of magnesium sulphate (Epsom salts) during 1928 reached a total of 2,508 short tons, valued at $47,717, compared with 2,404 tons, appraised at $39,195, in 1927.

Greece.[14]—Fifteen years ago more than 100,000 tons of magnesite was produced annually in Greece, and, although in recent years the annual production has been less than it was before the war, magnesite now constitutes one of the more important mineral exports. About one-half of the crude and a small part of the calcined material are shipped to Great Britain, but the exports of calcined magnesite are largely divided between the Netherlands and Germany. Most of the caustic calcined magnesite imported into the United States from Europe is of Greek origin; relatively small amounts, however, are imported direct, as most of it is ground in Holland. A large part of the magnesite used for stucco both in the United States and in Europe is mined in Greece.

Greek magnesite is relatively pure, an average analysis being, in per cent, $MgCO_3$, 95.12; $CaCO_3$, 4.02; Fe_2O_3, 0.08; SiO_2, 0.52; H_2O, 0.27. The material comes principally from the island of Eubœa, but smaller amounts are obtained from the Khalkidike Peninsula.

Prices of Grecian magnesite have remained fairly constant for several years. In December, 1926, raw magnesite was quoted, f. o. b. port of loading and including sacks, at 27s. a metric ton; caustic calcined and dead-burned magnesite were both quoted at 110s. a metric ton. According to Thoenen,[15] clean magnesite ore can be mined and delivered aboard steamers for between $2.50 and $5 a ton, according to the cost of transport to seaboard. Miners are paid 50 to 60 drachmas (62½ to 87½ cents) a day of eight hours. Common labor receives only 40 drachmas (50 cents) and women 22 drachmas (27½ cents) a 10-hour shift.

On the island of Eubœa the deposits occur mainly in a serpentine belt, 11 miles long, stretching from Limni to Kymassi, on the Ægean coast. The average width of the belt is from 3 to 4 miles, and it intrudes into Cretaceous limestone and is overlain in places by Tertiary conglomerates, marls, and marly limestones.

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[14] Wray, D. A., Greece: Its Geology and Mineral Resources: Min. Mag. (London), vol. 40, March, 1929, pp. 148–150.

[15] Thoenen, J. R., Mining Grecian Magnesite: Eng. and Min. Jour., vol. 125, Apr. 21, 1928, pp. 644–648.

There are nine principal workings on the island, four of which are conducted by the Anglo-Greek Magnesite Co. (London), which controls fully 50 per cent of the total output. One of the most important areas lies close to Limni, on the northwestern coast of the island; it is leased from the monastery of Galataki. The chief workings are at Kakabos and Archangelos. The calcining plant, the electric power plant, and the workshops are on the Gulf of Atalanti, 3 miles south of Limni, and are connected with the mines by an aerial ropeway 3 miles long and by a narrow-gage railway. Mining began at the outcrop but has been carried downward by means of an inclined shaft. At a depth of 120 feet there are no signs of exhaustion. The annual production of the Anglo-Greek group is about 20,000 tons; about 300 hands are employed.

D. A. Wray, in his article upon the geology and mineral resources of Greece, published in the Mining Magazine (London) of March, 1929, pp. 148–150, says:

> The oldest and most extensive magnesite workings in Greece are at Mantoudi, 8 miles east of Limni, in northern Eubœa. These were commenced some 60 years ago and are now held by a private Greek company. The main deposit is 1,800 feet long and is over 130 feet wide in places; it consists largely of a series of thick lenses of magnesite. Up to the present, about 1,500,000 tons of magnesite have been extracted; and although mining has been continued to depths of over 350 feet, there is little sign of any decrease in the size of the deposit. The principal workings at Koofala and Geroremma are close to Mantoudi and about 1½ miles from the small port of Kymassi. A narrow-gage railway and aerial ropeways connect the several workings. The calcining furnaces are of varying types, and the crude mineral is here fired with lignite mined locally. Magnesia fire bricks are manufactured at Mantoudi on a fairly large scale.
>
> At Daphnopotomous, 3 miles from Mantoudi, another Greek company is working a very pure deposit of magnesite. The average width of the vein is here from 4 feet to 5 feet, and it shows no sign of exhaustion at a depth of 60 feet.
>
> Among other localities in which magnesite is being worked are Pili, Gerakini, and Hagia Anna, all in northern Eubœa. At Pili, where two companies are operating, the deposits are of an irregular nature, whereas at Hagia Anna, to the north of Mantoudi, the average width of the principal vein is stated to be 6 feet.
>
> A Dutch concession, known as the Huyzer Co., has smaller mines at Limni and also at Afrati, near Chalcis. The former is provided with an aerial ropeway and has two calcining furnaces. The combined annual production of these two mines is about 15,000 tons. The Anglo-Greek Co. also has workings at Afrati.

On the Greek mainland magnesite was formerly worked on a small scale at Skender Agha, close to the town of Atalanti, and in the Province of Lokris. On the Khalkidike Peninsula, however, there are deposits of greater economic importance. Here also, the Anglo-Greek Co. is the principal operator, where in 1922 it purchased the Yerakini concession about 3 kilometers inland from the Gulf of Cassandra, which is reached by means of a narrow-gage (Decauville) railway. New kilns (coal-fired) were erected at this property. Canaris and Georgiades operate a large concession at Vavdos, 20 miles southeast of Saloniki, but production is limited. The calcining equipment consists of only three small bottle-shaped kilns of 12 tons capacity each. Brushwood is used for fuel. The product is shipped by motor truck 22 kilometers to Souflar. The Aghia Paraskevi concession, about 30 kilometers from Saloniki, is operated by Souliotis & Co., has three small brushwood-fired kilns, and exports by way of Mikra. The annual output for the mainland is about 1,000 tons; the magnesium carbonate content is stated to be 95.50 per cent.

The most important localities where occurrences of magnesite have been reported but not worked are Papades, in northern Eubœa; Perachori, near Corinth; Hermione (or Kastri), in southern Argolis; around Thebes, in Bœotia; and on the islands of Spetsai and Paros.

Manchuria.—Very large deposits—estimated at 200,000,000 tons—of high-grade magnesite have been discovered in the Liao-Tung Peninsula. They are owned by the South Manchurian Railway Co. and are close to its line. After being described by K. Niionomy early in 1925 they have formed a topic of controversy among Japanese geologists, whose opposing views have been briefly summarized by Kato,[16] who, after confirming in general Niionomy's observations, concludes that beds and lenses of magnesite and dolomite were formed through the action of hydrothermal solutions containing much magnesite and probably representing a differentiate from the same magma that formed near-by masses of granite and minette dikes. No progress has been reported with respect to economic utilization of this material.

Russia.[17]—In 1913 Russia produced 60,617 metric tons of magnesite, all of which came from the Satkinsky deposit. In 1922–23 the Khalilovsky deposit in the Government of Orenburg and one or two other deposits also became productive. During the next two or three years the Khalilovsky deposit continued to produce, but in 1925–26 virtually all the output again came from the Satkinsky deposit. Several of the other deposits, however, apparently have considerable potential importance, the Khalilovsky deposit being reputed to contain 3,000,000 tons. An analysis of the magnesite, which is white and amorphous, shows: MgO, 44.22 per cent; CaO, 3.05 per cent; $Al_2O_3+Fe_2O_3$, 0.43 per cent; SiO_2, traces; and volatile, 51.13 per cent.

In 1913 Russia imported 2,143 metric tons of crude and 4,855 tons of "calcined." Subsequently, however, there have been no imports in appreciable quantities. In addition to supplying home requirements Russia has developed some export trade; 1,059 tons of dead-burned magnesite appeared in the export statistics for 1925–26.

The prices of caustic calcined magnesite have doubled since 1912.

Venezuela.—Large deposits of magnesite have been worked on the island of Margarita, about 200 miles from the port of La Guaira. The magnesite is white, dense in structure, and apparently quite free from harmful impurities. In 1913 shipments amounting to 2,000 metric tons were made to the United States, and in 1916 the shipments increased to a maximum of 6,360 tons. Since then, partly because of litigation between the owner and the lessee, production has been intermittent. This magnesite was offered before the war for $7 a ton (freight $2.25 a ton), delivered in New York from Manzanillo. As there are no other industries on the island, labor is apparently plentiful and cheap, unskilled workers receiving the equivalent of 60 cents a day.

Available information indicates that several other Venezuelan deposits are extensive and that magnesite could be produced therefrom and delivered in the United States at low cost; however, no recent developments have been reported and there are as yet no calcining plants that are in a position to handle the material economically.

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[16] Kato, Takeo, The Origin of the Manchurian Magnesite Deposits: Econ. Geol., vol. 24, 1929, pp. 90–93

[17] Annual Report of the Mineral Resources of the U. S. S. R.: Vol. 1, 1925–26, Leningrad, 1927, pp. 355-361

Yugoslavia.—New deposits have been discovered in Milicevate and Sresojevats in the municipality of Ljubich, and near the railroad station of Premina, and a 50-year concession is reported to have been given on a 550-hectare tract.[18] Samples analyzed in the local university show little iron, silica, or alumina, and a remarkably low lime content.

The official statistics show for the first time a small production (1,680 metric tons in 1927) of magnesite from one mine.

In 1928 deposits were discovered in Serbia 35 kilometers from the Uzice-Valjero section of the Zaietchar-Sarajevo narrow-gage railway. Seven drill holes are said to have indicated a deposit of 2,000,000 tons of pure white, finely-crystalline material, almost free from lime and containing about 0.3 per cent of total combined iron and aluminum oxides and silica.[19]

DOLOMITE

DOLOMITE PRODUCTS

Dolomite for open-hearth lining is usually precalcined. The raw material is crushed, calcined, mixed with a small amount of tar or molasses, and tamped to a depth of 1 or 2 feet over a basic lining of fire brick. The essential requirements for a good lining are (1) refractoriness, (2) resistance to corrosion by slag or metal, (3) absence of disintegration on cooling, (4) absence of cracking on heating, (5) mechanical strength, and (6) low cost. Unless dolomite is low in impurities, it is not refractory; preferably it should contain at least 35 per cent of magnesium carbonate and it should not contain more than 1 per cent of silica or more than 1½ per cent of the combined oxides, $Fe_2O_3 + Al_2O_3$. Dolomite for patching on slag lines is used uncalcined.

A number of processes have been devised for obtaining magnesium compounds commercially from dolomite. The pipe-covering manufacturers have fairly well-standardized methods for producing basic carbonate from dolomite in a single cycle of operations. A French patent[20] recently reported employs sodium bisulphate as the attacking agent. Koehler (United States Patent 1664630, April 3, 1928) proposes treating the raw dolomite with magnesium chloride and then calcining it to obtain magnesium oxide and calcium chloride. A second portion of raw dolomite is calcined, and the mixed oxides are treated with this calcium chloride and carbon dioxide obtained in the previous reaction in order to form lime carbonate and magnesium chloride, which latter can be used over again in continuing the process. The Everhart process consists essentially of treating the calcined dolomite with acetic acid, which dissolves out the lime as acetate, from which acetic acid can, of course, be regenerated by means of sulphuric acid.

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[18] U. S. Bureau of Foreign and Domestic Commerce, Foreign Trade Notes: No. 153, Aug. 6, 1927, p. 2.

[19] Patton, K. S., U. S. Consul, Belgrade, New Deposits of Magnesium Ore: Consular Rept., Oct. 11, 1928, Bureau of Mines Foreign Files, 9904.

[20] van der Bergh, F., French Patent 616644, May 25, 1926. Chim. et Ind., vol. 20, September, 1928, p. 470.

Crude dolomite sold by producers in the United States for certain uses, 1919–1928, in short tons

[Includes dead-burned dolomite, basic magnesium carbonate, sulphite process of paper manufacture, and making of carbon dioxide]

1919	947, 000	1924	1, 239, 000
1920	1, 580, 000	1925	1, 425, 000
1921	499, 000	1926	1, 480, 000
1922	1, 074, 000	1927	1, 355, 000
1923	1, 226, 000	1928	1, 605, 000

DEAD-BURNED DOLOMITE

The principal use of dead-burned dolomite is that as refractory material. Some manufacturers of this product buy their stone, the sales of which are reported by the quarry companies in terms of crude stone; others quarry their own stone and report only in terms of dead-burned material. The two kinds of material are represented in the accompanying table, as well as the estimated total output in terms of dead-burned dolomite.

Dead-burned dolomite sold or used by producers in the United States, 1919–1928

Year	Reported as raw stone		Reported as dead-burned		Total quantity calculated as dead-burned (short tons)
	Short tons	Value	Short tons	Value	
1919	254, 787	$394, 754	222, 036	$2, 228, 602	349, 000
1920	612, 800	742, 020	316, 293	3, 732, 522	623, 000
1921	79, 480	85, 786	107, 664	1, 113, 010	147, 000
1922	146, 640	172, 251	348, 838	2, 813, 946	422, 200
1923	205, 890	249, 993	357, 642	3, 599, 116	460, 600
1924	309, 010	287, 137	328, 659	3, 209, 257	483, 200
1925	415, 710	375, 315	392, 145	3, 730, 509	600, 000
1926	511, 300	458, 802	386, 715	3, 593, 731	642, 000
1927	434, 160	424, 140	374, 415	3, 459, 803	591, 000
1928	522, 850	509, 502	448, 761	4, 283, 036	710, 000

BASIC MAGNESIUM CARBONATE

Basic magnesium carbonate, or "technical carbonate," used in "85 per cent magnesia" pipe and boiler coverings increased in output in 1928. The manufacturers of this product both buy and quarry their stone but do not report their output of finished product. The crude stone used for this purpose in the last 10 years has been reported as follows:

Dolomite sold or used by producers in the United States for manufacture of basic magnesium carbonate, 1919–1928

Year	Short tons	Value	Year	Short tons	Value
1919	62, 652	$82, 619	1924	98, 160	$129, 390
1920	57, 300	107, 107	1925	98, 980	131, 440
1921	32, 050	60, 648	1926	72, 850	110, 560
1922	53, 170	79, 313	1927	69, 940	115, 932
1923	116, 410	146, 337	1928	94, 200	122, 260

HIGH-MAGNESIUM LIME FOR SULPHITE PAPER MILLS

An estimate of the high-magnesium lime sold to sulphite paper mills in the last 10 years is given below. Exact figures are impossible to obtain, as many lime producers who sell burned lime to paper mills do not specify the kind of paper mill. The quantity sold is expressed as burned lime.

High-magnesium lime sold by producers in the United States to sulphite paper mills, 1919–1928

Year	Short tons	Value	Year	Short tons	Value
1919	83, 962	$632, 930	1924	70, 000	$625, 000
1920	121, 817	1, 347, 321	1925	53, 000	451, 000
1921	68, 992	711, 345	1926	52, 600	482, 000
1922	70, 000	650, 000	1927	50, 000	441, 000
1923	75, 000	750, 000	1928	46, 000	359, 000

CARBON DIOXIDE

Sales of crude dolomite for the manufacture of carbon dioxide in the last 10 years are as follows:

Dolomite sold by producers in the United States for the manufacture of carbon dioxide, 1919–1928

Year	Short tons	Value	Year	Short tons	Value
1919	16, 870	$39, 895	1924	34, 600	$57, 105
1920	33, 040	73, 671	1925	19, 740	36, 854
1921	34, 090	124, 984	1926	16, 520	31, 424
1922	38, 280	58, 748	1927	(1)	(1)
1923	38, 460	52, 494	1928	(1)	(1)

[1] Bureau of Mines not at liberty to publish figures.

MAGNESIUM

PRODUCTION

The magnesium industry in 1928 again surpassed all previous records in both production and consumption of the metal. The domestic production of ingot, totaling about 521,000 pounds, increased 67 per cent over the production in 1927. The total sales of domestic magnesium increased 32 per cent as compared with 1927. Of the total sold in 1928, 71 per cent was ingot, 2 per cent sheet, 6 per cent powder, 12 per cent castings, and 9 per cent miscellaneous (chiefly forgings). Sales of ingot increased more than 37 per cent and sales of castings increased 75 per cent, as compared with 1927, but sales of sheet decreased 23 per cent.

Domestic sales from 1919 to 1928 are shown in the table that follows.

Domestic metallic magnesium sold or used in the United States, 1919–1928

Year	Pounds	Value	Average price per pound		Year	Pounds	Value	Average price per pound	
			Ingot	Powder				Ingot	Powder
1919	127,465	$247,302	$1.83	$2.85	1924	[2] 128,000	[2] $150,000	[3] $1.07	[4] $1.10
1920	(1)	(1)	1.60	2.75	1925	245,000	274,400	.86	1.63
1921	48,000	86,000	1.30	2.36	1926	322,650	390,400	.80	1.64
1922	[2] 60,000	[2] 89,000	1.60	1.13	1927	366,400	441,700	[5] .68	1.56
1923	[2] 125,000	[2] 155,000	1.25	1.00	1928	483,000	587,000	.82	1.51

[1] Bureau of Mines not at liberty to publish figures.
[2] Estimated.
[3] Prices ranged from as low as 90 cents in large contracts to $1.10 for small quantities. The published price established about Mar. 1, 1924, was $1.
[4] This price is an average for old powder sold in competition with old imported stocks and for new powder, manufacture of which began in October, 1924, at a sales price of $1.50 a pound.
[5] This price includes that of sales of crude ingot to large consumers for fabricating.

In recent years the domestic output has been supplied by two companies—the American Magnesium Corporation, producing the metal at Niagara Falls, N. Y., from selected caustic calcined magnesia and using a process similar to that employed in the manufacture of aluminum, and the Dow Chemical Co., producing magnesium from magnesium chloride recovered as a by-product at its salt wells at Midland, Mich. In May, 1927, the American Magnesium Corporation ceased the manufacture of ingot magnesium by the oxide process and thenceforth has purchased its requirements from the Dow Chemical Co. It has confined its activities to the partial fabrication of the metal in the form of extruded bar, alloys, castings, forgings, sheet, wire, and powder, and in July, 1928, its fabricating equipment was moved from Niagara Falls to the plant of the United States Aluminum Co., at Cleveland, Ohio, where these different forms are produced. The pig metal is produced in the form of billets, 3 by 3 by 15 inches, or in round sections, 4 inches in diameter and 16 inches long. Commercial ingots, which are remelted or extruded from this crude pig, are mostly round bars from 12 to 27 inches long and from ½ inch to 1⅜ inches in diameter.

The United States Metallic Magnesium Co., capitalized at $1,000,000, filed articles of incorporation early in March, 1929. The officers of the company are J. T. Hammond, president; H. S. Stonner, vice president; and R. E. Hammond, secretary and treasurer. The foregoing officers, together with B. S. Ropp, W. Hogden, L. L. Daines, and W. B. Passey, are the directors. It is reported[21] that this company proposes to manufacture metallic magnesium from dolomite at Logan, Utah.

The Elektron Metals Corporation of America, which formerly imported magnesium from Germany, suspended operations in 1924.

In Germany metallic magnesium is produced at Hemelingen and at Bitterfeld; elektron, a magnesium-zinc alloy, is made at the Greisheim works at Eberfels. In France a very pure magnesium, known as michel metal, or as maxium metal, is made at Messières, in Savoy; extruded shapes, castings, and forgings are made by the Société Electrochimie at Mantupet. French supplies of ingot, however, are obtained mainly from Germany. The same thing is true of Italy, where the metal is further manufactured in the works of the Isotta Fraschini Co. United States Consul James B. Young reports that before the end of 1929 three industrial plants will be in operation in Venice for the manufacture of aluminum and magnesium and alloys of the two metals. In England the British Maxium Co., of Wandsworth, and Everett & Co., of Liverpool, are dealers in the metal.

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[21] Salt Lake Mining Review: Mar. 15, 1929 . 19.

IMPORTS

Beginning with 1924 imports of magnesium, chiefly from Germany, have constituted about 4 per cent of the domestic consumption. In 1928 there was a notable increase in total imports, owing chiefly to the fact that imports of powder almost doubled.

Magnesium imported for consumption in the United States, 1919–1928

Year	Pounds	Value		Year	Pounds	Value	
		Total	Average			Total	Average
1919	13, 239	$13, 583	$1. 02	1924	8, 738	$6, 561	$0. 75
1920	29, 275	25, 055	. 85	1925	8, 326	7, 070	. 85
1921	39, 913	30, 592	. 77	1926	10, 117	4, 750	. 47
1922	182, 939	54, 448	. 30	1927	7, 131	8, 402	1. 18
1923	13, 974	11, 576	. 83	1928	12, 039	11, 890	. 99

Magnesium imported for consumption in the United States, 1927–28, by classes

Class	1927			1928		
	Pounds	Value		Pounds	Value	
		Total	Average		Total	Average
Alloys (magnesium content)	----------	----------	----------	20	$57	$2. 850
Magnesium, metallic and scrap	611	$400	$0. 655	1, 000	1, 048	1. 048
Powder (magnesium content)	5, 595	6, 363	1. 137	10, 133	9, 443	. 932
Sheets, tubing, ribbons, wire, and all other articles of magnesium	925	1, 639	1. 772	886	1, 342	1. 515
	7, 131	8, 402	1. 178	12, 039	11, 890	. 988

DEVELOPMENT AND OUTLOOK

Increasing quantities of magnesium are being used in all of its more important applications. The greatest increase has been as a minor alloying ingredient in both cast and wrought aluminum alloys. The consumption of the metal in magnesium-base castings and fabricated parts has grown so that it now equals, or even exceeds, the consumption of the metal as a deoxidizer of other metals. Forging and extrusion billets are now available in sizes and quantities to meet the demands of metal fabricators. Forged airplane propellers made from extruded stock have proved highly satisfactory; low weight and high fatigue endurance are two valuable factors contributing to the success of these propellers. Aircraft building has long been considered a promising field for magnesium, and considerable success has attended its use in aircraft motor castings and propellers and in some other forged parts of engines. For many structural parts, however, where great strength is needed, certain aluminum alloys would seem to be superior, weight for weight. Duraluminum, for example, has 60,000 pounds ultimate tensile strength and 20 per cent elongation and is only one-third heavier than magnesium, which has a strength of only 40,000 pounds per square inch and 8 per cent elongation. A new development in the casting field is the quantity production in the United States of heat-treated magnesium-base alloy castings containing 7 per cent of aluminum and 0.4 per cent of manganese. As high as 30,000 pounds tensile strength for 8 to 10 per cent elongation has been obtained in tests of this alloy.

The increasing general interest in magnesium alloys is seen in the activities of the American Society for Testing Materials. A new committee on light metals and alloys has been organized recently, and one of the subcommittees of this group is devoted to the study of magnesium-base alloys.

Bureau of Standards Circular 346, Light Metals and Alloys—Aluminum and Magnesium, issued in December, 1927, brings together data on properties, statistics, and manufacture of light metals and alloys, gives briefly the fundamental properties of the metals and alloys, and contains references to the literature and a complete bibliography. The thermal expansion of magnesium and some of its alloys is covered in a later paper.[22]

According to W. Koehler, magnesium vapor may be produced in an electric furnace in the presence of hydrogen and then carried out of the furnace and condensed in the gas. Koehler claims also that metallic magnesium and calcium carbide can be produced jointly in an electric furnace from dolomite.[23] A. C. Jessup obtained a British patent (No. 269864, April 22, 1926) for producing alloys by the electrolysis of a fused magnesium salt, a fused cathode being used. An alloy thus obtained can then be used as an anode in a secondary cell for obtaining magnesium.

As reported in the Iron Age,[24] E. Player, of the Sterling Metals (Ltd.), of Coventry, England, declares that the manufacture of magnesium alloy castings is no longer in the experimental stage. Magnesium forms alloys with zinc, aluminum, and copper, all of which have excellent casting qualities and physical properties; the copper alloys, however, are not widely used, as they are subject to corrosion. Magnesium alloys can be machined at considerably higher speeds than most other metals, and a fine and accurate finish is obtained without the necessity of costly finishing work. Elektron, the German brand of magnesium alloys, is finding increasing application in constructional engineering abroad. Magnesium sheet can be worked to most shapes, although for deep pressing the work has to be carried out in a number of stages, with suitable annealing after each operation. The difficult problem of making satisfactory welded joints has been solved, according to this authority.

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[22] Hidnert, Peter, and Sweeney, W. T., Thermal Expansion of Magnesium and Some of its Alloys: U.S. Bureau of Standards Research Paper 29 (reprint from Bur. Stand. Jour. of Research, November, 1928).

[23] Chemistry and Industry, Production of Magnesium from Dolomite: Vol. 47, No. 5, London, Feb. 3, 1928, pp. 95–96.

[24] Player, E., Magnesium Alloy Castings Now Commercial: Iron Age, Jan. 31, 1929, p. 334.

Figures on production of magnesium in Germany have not been published since 1925, when the output was 1,500 tons. From unofficial sources it is reported that current production in Germany is 4,500 to 5,000 tons annually, and statements have been made that the output for 1929 may be as much as 10,000 tons. A more conservative estimate, which may be considered reliable, places the 1928 production in Germany between 2,500 and 3,000 tons, or somewhat more than 10 times the output in the United States. An outstanding German producer is the I. G. Farbenindustrie, the German dye stuff corporation or trust. Publicity has been given an agreement between the Aluminum-und-Magnesiumfabrik A.-G., of Hemelingen (near Bremen), and the I. G. Farbenindustrie for rights to produce magnesium alloys with various refractory metals (notably chromium) for use as catalyzers. Such alloys are claimed to be equal to catalyzers containing platinum or osmium and for some synthetic processes to be even superior to them.[25]

In the Annual Survey of American Chemistry of the National Research Council Dr. J. A. Gann,[26] of the Dow Chemical Co., reviews the progress of magnesium and beryllium. Protective coatings are briefly described. Metallurgical progress during the year has shown a better understanding of heat treatment and age hardening of the alloys of these metals. Press-forged magnesium alloy automobile-engine pistons of high strength and improved thermal conductivity are a recent successful development.

In the field of theoretical metallurgy the year has brought forth a most complete study of the aluminum-beryllium alloys by Archer and Fink, of the Aluminum Co. of America.

Gann and Winston [27] have published an article giving the results of physical tests of the mechanical properties of several high-magnesium alloys, into some of which manganese is introduced to reduce corrosion and improve the mechanical properties. The microstructures of 25 of these alloys are shown, and the technique of etching and polishing the samples is discussed. The article includes complete directions for foundry practice and gives a list of possible uses of these alloys.

Many schemes are proposed to prevent oxidation of magnesium; several of them provide for treating with a solution of fluoride, either alone or as a preliminary to applying varnish or lacquer. For protecting molten metal magnesium fluoride or mixtures of fluorides and ammonium chloride are proposed.

A method of coating other metals with aluminum or magnesium or other alloys has been patented by R. Hopfelt and C. P. Nolden (British Patent 278415, July 1, 1926). The coating is produced by spraying, by electroplating, or by mixing the powdered coating metal with water glass (or silica), or with kaolin, magnesia, or other material applied as a paste, then subjecting the article to the heat treatment at a moderately high temperature (800° to 2,200°). Another English patent granted to the I. G. Farbenindustrie (British Patent 275985, August 13, 1926) covers alloys, having the composition of 15 per cent of aluminum and 1 to 6 per cent of silicon, for internal-combustion engines.

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[25] Claiborne, Hamilton C., Weekly Notes on German Chemical Industry: U. S. Dept. of Commerce, Dec 21, 1927.

[26] Gann, J. A., Progress in the Metallurgy of Magnesium and Beryllium: Metal Ind. (London), vol. 33, No. 26, Dec. 28, 1928, p. 610.

[27] Gann, J. A., and Winston, A. W., Magnesium and Its Alloys: Ind. and Eng. Chem., vol. 19, 1927, pp. 1193-1201.

During 1928 prices of magnesium in the United States were quoted[28] as follows for ton lots: For 8-pound ingot (3 by 3 by 16 inches), $0.98 a pound from January to August, changing to $0.85 to $1.05 for September and subsequent months; for 2½ or 3 pound sticks (1⅜ inches), $0.95 to $1 from January to August and $0.90 to $1.10 from September to December; for 10-ounce sticks (1 by 12 inches), $0.85 to $0.90 throughout the year. Discounts up to 20 per cent were offered on larger orders or contracts. London prices for 99 per cent ingot, or sticks, were 3s. 9d. to 4s. 3d. a pound at the beginning of the year; after minor readjustments were made during the summer months prices were reduced in November to 3s. 3d. to 3s. 9d. The British prices are not strictly comparable with those quoted in the American market as the qualities are not exactly the same, but it may be noted that the average of the prices quoted in London at the end of the year was equivalent to almost 85 cents a pound, or only a trifle less than the quotations in the American market which is protected (under the tariff act of 1922) by a duty of 40 cents a pound on metal plus an additional 20 per cent of the foreign market value on alloys, powder, or manufactured forms.

MAGNESIUM SALTS

The production of magnesium salts, largely magnesium sulphate and chloride, from natural salts and bittern waters in the United States in 1928 was 70,909,805 pounds, valued at $1,020,044. There were less than three producers each of magnesium sulphate and magnesium chloride and the Bureau of Mines is not at liberty to publish production figures separately.

Commercial magnesium chloride (guaranteed 97 per cent of $MgCl_2.6H_2O$), made from natural brine and bittern waters, was produced and sold by two companies in 1928—the California Chemical Corporation, San Francisco, Calif., and the Dow Chemical Co., Midland, Mich. Anhydrous magnesium chloride is marketed in the United States in small quantities but it is manufactured mostly by the Dow Chemical Co. for use in its own plant for the manufacture of metallic magnesium. The hydrated material, sometimes known as 6-molecule salt, is used chiefly with caustic calcined magnesite in the preparation of oxychloride cement. Some years ago liquid chloride of about 50 per cent grade was used, but at the present time only domestic "flake," imported "crystal," or fused salt is employed. A short ton of domestic flake is said to contain the equivalent of 2,070 pounds of $MgCl_2.6H_2O$, whereas a short ton of imported crystals contains the equivalent of only 1,960 pounds of hydrated salt. Germany produces about three times as much magnesium chloride as the United States and is the chief source of American imports. Domestic flake chloride was quoted in New York at $37 a short ton in 1928. Domestic fused chloride ordinarily sells for about $2 a ton less than flake. Imported fused chloride was quoted in 1928 at $31 a ton delivered, duty paid. In 1928 the German inland price of magnesium chloride, solid, technical, ranged from $9.80 to $15.40 a short ton, and the export price from $20.40 to $21.60 a ton.

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[28] Engineering and Mining Journal: Vols. 125 and 126, 1928.

Magnesium chloride imported for consumption in the United States, 1919–1928

Year	Anhydrous			Total		
	Pounds	Value		Pounds	Value	
		Total	Average		Total	Average
1919	(1)	(1)		11,200	$538	$0.048
1920	(1)	(1)		454,334	7,098	.016
1921	(1)	(1)		7,365,812	85,727	.012
1922	(1)	(1)		11,403,837	113,618	.010
1923	56,110	$2,703	$0.048	23,052,385	190,748	.008
1924	136,082	1,820	.013	15,200,433	85,206	.006
1925				15,922,254	105,462	.007
1926				16,093,867	110,477	.007
1927	44,374	315	.007	8,185,363	59,950	.007
1928	427,114	3,125	.007	5,799,750	41,712	.007

(1) Not separately recorded.

Magnesium sulphate from natural sources was produced in the United States by only one company in 1928—the Dow Chemical Co., Midland, Mich. The magnesium sulphate deposits near Oroville, Okanogan County, Wash., owned by the Magnesium Products Co., of Portland, Oreg., were not productive in 1928, although some sales of refined Epsom salts were made locally and in western Washington. A deposit, said to contain at least 1,000,000 tons of epsomite, is reported as in San Bernardino County, Calif., about 28 miles from Searles Lake. It is proposed to treat this material with trona to produce magnesium carbonate and Glauber's salts.

Epsom salts of technical grade was quoted in New York at $1.70 per hundred pounds throughout the greater part of 1928. The U. S. P. grade was quoted at $2.25 for the domestic product and at $1.95 for the imported. In Germany the inland price of Epsom salts was $0.43 per hundred pounds, and the export price ranged from $0.386 to $0.513. The technical grade is used for sizing textiles and for weighting silks, paper, and leather, and the United States Pharmacopœia grade is used as a laxative and in various other medicinal preparations. A solution of magnesium sulphate is used in the manufacture of artificial silk by the viscose process. According to a report from Consul Hamilton C. Claiborne,[29] in Germany 4 to 4½ tons of the salt is consumed for every 1,000 kilos of the finished rayon; hence a large factory may use 45 tons in one day.

Magnesium sulphate (Epsom salts) imported for consumption in the United States, 1919–1928

Year	Pounds	Value		Year	Pounds	Value	
		Total	Average			Total	Average
1919	17,647	$1,473	$0.0835	1924	8,881,181	$57,579	$0.0065
1920	1,803,769	66,944	.0371	1925	8,211,228	50,466	.0061
1921	12,519,778	88,153	.0070	1926	10,600,582	61,018	.0058
1922	25,390,734	200,203	.0079	1927	11,620,675	60,527	.0052
1923	14,455,920	71,566	.0050	1928	10,459,596	61,600	.0059

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[29] Claiborne, Hamilton C., U. S. Dept. of Commerce, World Trade Notes on Chemicals and Allied Products: Vol. 2, May 21, 1928, p. 2.

In Germany magnesium chloride is a by-product of the production of potassium chloride from the Stassfurt salt deposits. As there is a large surplus of magnesium chloride liquors, the expense of producing the commercial chloride consists principally of evaporating and packing costs. Kieserite (natural magnesium sulphate) also is found in the Stassfurt potassium deposits. The German makers of magnesium chloride are organized into a syndicate with headquarters at the offices of the Rock Salt Syndicate in Berlin; the makers of magnesium sulphate organized December 3, 1927, as the Bitter Salt Syndicate.

The German magnesium salt industry in 1928 has been summarized, as follows:[30]

> Carnallite ($KCl.MgCl_2.6H_2O$) is one of the chief salts occurring in Germany's natural soluble potash deposits. Before the war carnallite was worked extensively for recovery of its potassium chloride content for fertilizer. A small fraction, according to market demand, was processed for commercial magnesium chloride and bromine, and some 800,000 metric tons of magnesium chloride were discarded annually. The waste liquors containing this compound were dumped in the rivers of central Germany and created a serious stream pollution problem, while the costs of processing carnallite were greater than for sylvinite, or hard salts, and the process more complicated.
>
> In 1913 Germany mined 5,486,000 tons of carnallite, which represented 47 per cent of the crude potash mined that year. Since the war, much less carnallite has been mined and more of the salts of higher potash content. In 1927 only 1,773,200 tons of carnallite were mined, which was 16 per cent of the total German potash recovered in that year. The same condition applied in 1928.
>
> Carnallite is used for local magnesium chloride manufacture and for magnesium metal. Two or three mines sell their output of specially pure carnallite to the Griesheim Elektron works for electrolytic production of magnesium for its light metal alloy, Elektron, which has a 90 per cent magnesium content. Carnallite producers dispose of about 50,000 tons of solid magnesium chloride annually in other ways and 5,000 tons in 12 per cent liquid form. Only solid magnesium chloride enters export.
>
> Producers are combined in the magnesium chloride syndicate, Berlin, concurrent with the rock salt and bromine syndicates. Rock salt is produced with potash and bromine by treatment of carnallite liquor with chlorine.
>
> Hard salt is a mixture of sylvin (KCl), kieserite ($MgSO_4.H_2O$), rock salt, and anhydrite ($CaSO_4$). Kieserite, as noted, is practically pure magnesium sulphate. Both are prominent in German potash deposits. While these are raw material for potassium chloride fertilizer, they furnish an oversupply of magnesium sulphate, of which some 125,000 tons enter the market annually as bitter salts (the technical grade) or Epsom salts (pharmaceutical grade). Much magnesium sulphide is lost in waste liquors; before the war some 100,000 tons were dumped annually.

Since 1924 Russia has been producing magnesium chloride at a rate of 1,000 tons or more annually. England's exports (1923–1925) ranged from 4,000 to 5,000 tons of chloride and sulphate a year. Small quantities of magnesium salts are exported from France, Italy, and Austria also. India produces important quantities, especially of magnesium chloride. Next to Germany, however, the United States is apparently the largest producer of magnesium salts.

In addition to the production from natural brines, magnesium sulphate is manufactured in the United States by dissolving magnesite or dolomite in sulphuric acid with subsequent crystallization. Commercial magnesium carbonate is a white, bulky powder, insoluble in water. The crude grade, technical carbonate, is used largely as an insulating material for furnaces and steam pipes and as a filler for rubber, paper, paint, and like products. The pure grade is used in medicine, in tooth and face powders, and in metal and glass polishes. The Marine Chemicals (Inc.), South San Francisco, Calif., in 1928 produced some magnesium carbonate by a patented process from ocean water for experimental purposes; magnesium carbonate was produced also from salt-works bitterns by the California Chemical Corporation, San Francisco. The wholesale price of magnesium carbonate (technical) in the New York market in 1928 was 6 cents a pound.

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[30] Daugherty, William T., German Chemical Development in 1928: U. S. Bur. of For. and Dom. Com. Trade Information Bull. 605, 1929, pp. 24–25.

Magnesia is made on a large scale at Aigues-Mortes, on the Mediterranean coast of France, out of sea water, which contains [31] about 4 pounds of magnesium chloride per cubic yard. The magnesia is precipitated by milk of lime, 1.5 per cent of lime being added for each 1 per cent of magnesia.

Imports of magnesium compounds, not recorded elsewhere in this report, are shown in the table that follows.

Magnesium compounds imported for consumption in the United States, 1919–1928

Year	Calcined magnesia		Carbonate, precipitated		Year	Calcined magnesia		Carbonate, precipitated	
	Pounds	Value	Pounds	Value		Pounds	Value	Pounds	Value
1919	22,637	$11,358	5,094	$1,101	1924	101,998	$29,252	481,439	$25,333
1920	26,859	9,093	14,930	1,512	1925	162,790	43,356	190,413	13,004
1921	35,182	7,593	18,514	2,061	1926	520,394	51,454	241,293	16,142
1922	96,792	15,969	36,254	3,385	1927	259,357	48,093	348,383	20,115
1923	141,375	30,802	1,046,990	55,137	1928	300,897	60,325	283,264	17,512

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[31] Lock, C. G. W., Economic Mining, p. 331 (quoted by Eckel, E. C., in Cements, Limes, and Plasters 2d ed., New York, 1922, p. 160).

GYPSUM

By R. M. Santmyers and Jefferson Middleton

INTRODUCTION

The gypsum industry in 1928 was more or less disorganized because of severe competition and price cutting. This condition has continued since the latter part of 1926 and during the summer of 1928 reached its climax, the smaller producers being able only to hold their own. As a result the quantity and value of the gypsum products sold in 1928 were considerably less than in 1927.

Notwithstanding the low price for gypsum products, two new companies entered the field and several of the older companies expended considerable sums on new construction. The operating costs at the older plants were so high that the companies were compelled to reconstruct their plants in order to meet competition from newer more advantageously located and more economically operated plants.

All the new plants built or under construction during 1928, with one exception, are near the markets they are to serve and are supplied with crude gypsum from distant sources by cheap water transport.[1] This is in contrast to the older practice of building the mills at the mine or quarry and shipping the finished products long distances at relatively high freight rates. The market areas for individual plants are becoming more and more restricted as new plants are being built at large consuming centers. As a result of the geographical concentration of markets, however, the individual plants are tending to expand the variety of their products and thus operate with full working complement the year round. Consequently, there will be no off season, as experienced now, because as one product has its off season another will take its place.

All the plants recently constructed or under construction are of comparatively large capacity, of latest design embodying new machinery, and capable of low production costs. The gross tonnage that can be produced by these new plants plus the capacity of the older plants indicates a considerable increase in total potential capacity. The result, no doubt, will be the elimination of some of the older plants, especially those now supplying the larger cities in which the new plants are being built.

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[1] Rock Products, vol. 31, No. 26, Dec. 22, 1928, p. 137.

PRODUCTION

The quantity of crude gypsum mined in the United States in 1928 was 5,102,250 short tons, a decrease of 244,638 tons, or 5 per cent, compared with 1927. The number of operators in 1928 was 58, a decrease of 2 from 1927. The value of the sales of uncalcined and calcined gypsum by producers was $32,036,163, as compared with $42,174,454 in 1927 and $46,721,219 in 1926—a decrease from 1927 of $10,138,291, or 24 per cent, and from 1926 of $14,685,056, or 31 per cent. The value in 1928 is the smallest since 1922, when the total sales were valued at $29,361,151. Of the total quantity mined in 1928, 999,412 tons was sold without calcining (an increase of 34,041 tons over 1927) and was valued at $1,902,034 ($1.90 per ton or 57 cents less than in 1927). The sales of calcined gypsum by producers in 1928 amounted to 3,641,385 short tons, valued at $30,134,129, or $8.28 per ton; this is a decrease of 7 per cent in quantity, of 24 per cent in total value, and of $1.89 per ton, compared with 1927.

New York was, as usual, the largest producer of crude gypsum. Although the same number of operators were active in the State as during 1927, the production of crude gypsum was only 1,504,826 tons, or 10 per cent less than in 1927. New York was also, as usual, the largest seller of gypsum, marketing 268,691 tons without calcining, or 27 per cent of the United States total, and 1,068,222 tons calcined, or 29 per cent of the total. These figures represent decreases in quantity of 7 per cent and 17 per cent, respectively, as compared with sales in 1927.

Other important States in the production of crude gypsum in 1928 were as follows: Iowa, 764,044 tons; Michigan, 677,108 tons; Texas, 509,472 tons; Ohio, 413,948 tons; Oklahoma, 397,752 tons; and Nevada, 278,405 tons.

The quantity of crude gypsum sold by producers in 1928 as agricultural gypsum was 25,668 tons, valued at $90,937, as compared with 29,452 tons, valued at $129,825, in 1927, a decrease of 13 per cent in quantity and of 30 per cent in value.

As the statistical data collected for 1928 concerning the uses of calcined gypsum differ somewhat from those for previous years, it would not be satisfactory to compare certain of the items in 1928 with those for any earlier year.

The amount of calcined gypsum sold during 1928 for building purposes was 3,462,921 tons, valued at $28,482,285, or 95 per cent of both the total quantity and value of the sales of calcined gypsum. Sales of fibered plaster amounted to 1,549,483 tons, valued at $7,677,864—a little less than half (45 per cent) of the total quantity sold for building but only 27 per cent of the total value of such sales. Sales of neat plaster ranked second in quantity, amounting to 621,119 tons, valued at $3,631,518, or 18 per cent of the total quantity sold for building and 13 per cent of the total value. The third largest item in quantity was wall board, sales of which amounted to 459,177 tons (559,936,675 square feet), valued at $9,046,926, or 13 per cent of the total quantity sold for building and 32 per cent of the total value.

The amount of calcined gypsum sold during 1928 for manufacturing uses was 178,464 tons, valued at $1,651,844, or 5 per cent of both the total quantity and value of the sales of calcined gypsum. The largest item in quantity under this heading was plaster of Paris (molding and casting plaster, etc.), sales of which amounted to 67,067 tons, valued at $500,582, or 38 per cent of the total quantity sold for manufacturing uses and 30 per cent of the total value. The sales of Keenes cement during 1928 were 54,020 tons, valued at $848,504, or 30 per cent of the total quantity sold for manufacturing and 51 per cent of the total value. The reported sales of calcined gypsum to plate-glass works in 1928 were considerably larger than during previous years—35,830 tons, valued at $196,933, compared with 18,372 tons, valued at $132,203, in 1927—and represented 20 per cent of the total quantity sold for manufacturing and 12 per cent of the total value.

Gypsum mined and uncalcined and calcined gypsum sold by producers in the United States, 1919–1928

Year	Number of operators	Total quantity mined (short tons)	Sold without calcining		Sold calcined		Total value of sales
			Short tons	Value	Short tons	Value	
1919	57	2, 420, 163	510, 245	$1, 518, 203	1, 596, 020	$14, 209, 704	$15, 727, 907
1920	61	3, 129, 142	669, 260	2, 565, 195	1, 904, 484	21, 967, 870	24, 533, 065
1921	62	2, 890, 784	642, 944	2, 266, 011	1, 796, 851	21, 434, 279	23, 700, 290
1922	64	3, 779, 949	770, 725	2, 443, 346	2, 491, 265	26, 917, 805	29, 361, 151
1923	62	4, 753, 448	847, 242	2, 577, 436	3, 101, 378	32, 310, 719	34, 888, 155
1924	72	5, 042, 629	982, 108	2, 674, 320	3, 568, 569	40, 050, 187	42, 724, 507
1925	61	5, 678, 302	1, 014, 135	2, 823, 229	4, 096, 357	44, 754, 011	47, 577, 240
1926	59	5, 635, 441	961, 363	2, 509, 885	4, 015, 974	44, 211, 334	46, 721, 219
1927	60	5, 346, 888	965, 371	2, 388, 663	3, 912, 211	39, 785, 791	42, 174, 454
1928	58	5, 102, 250	999, 412	1, 902, 034	3, 641, 385	30, 134, 129	32, 036, 163

Gypsum mined and uncalcined and calcined gypsum sold by producers in the United States, 1927 and 1928, by States

State	Number of operators	Total quantity mined (short tons)	Sold without calcining		Sold calcined		Total value of sales
			Short tons	Value	Short tons	Value	
1927							
Iowa	7	792, 159	139, 637	$391, 701	584, 305	$6, 321, 796	$6, 713, 497
Kansas	3	175, 351	37, 027	67, 474	98, 737	908, 175	975, 649
Michigan	6	668, 617	178, 378	331, 837	429, 639	3, 884, 687	4, 216, 524
Nevada	5	327, 365	61, 303	184, 452	217, 931	1, 299, 719	1, 484, 171
New York	11	1, 675, 501	290, 368	792, 410	1, 291, 967	14, 096, 980	14, 889, 390
Ohio	3	474, 320	11, 210	30, 761	456, 817	5, 011, 118	5, 041, 879
Oklahoma	4	271, 484	(1)	(1)	(1)	(1)	2, 073, 944
Texas	4	508, 382	(1)	(1)	(1)	(1)	4, 003, 456
Other States [2]	17	453, 709	[3]247, 448	[3]590, 028	[3]832, 815	[3]8, 263, 316	2, 775, 944
	60	5, 346, 888	965, 371	2. 388, 663	3, 912, 211	39, 785, 791	42, 174, 454
1928							
Iowa	7	764, 044	154, 596	247, 263	565, 140	5, 107, 951	5, 355, 214
Kansas	3	126, 227	33, 782	51, 427	69, 974	884, 168	935, 595
Michigan	5	677, 108	199, 036	243, 891	460, 143	2, 915, 478	3, 159, 369
Nevada	5	278, 405	52, 878	162, 404	196, 348	1, 262, 051	1, 424, 455
New York	11	1, 504, 826	268, 691	636, 645	1, 068, 222	8, 976, 662	9, 613, 307
Ohio	3	413, 948	12, 359	30, 211	378, 664	3, 775, 584	3, 805, 795
Oklahoma	3	397, 752	(1)	(1)	(1)	(1)	2, 021, 635
Texas	4	509, 472	34, 521	52, 989	400, 015	3, 041, 156	3, 094, 145
Utah	3	28, 103	(1)	(1)	(1)	(1)	136, 766
Other States [2]	14	402, 365	[3]243, 549	[3]477, 204	[3]502, 879	[3]4, 171, 079	2, 489, 882
	58	5, 102, 250	999, 412	1, 902, 034	3, 641, 385	30, 134, 129	32, 036, 163

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[1] Included under "Other States."

[2] 1927: Arizona, California, Colorado, Montana, New Mexico, South Dakota, Utah, Virginia, and Wyoming; 1928: Arizona, California, Colorado, Montana, New Mexico, South Dakota, Virginia, and Wyoming.

[3] This figure includes also sales from States entered as "(1)" above.

Gypsum sold by producers in the United States, 1927 and 1928, by uses

Use	Short tons	Value
1927		
Without calcining:		
To cement mills	928,307	$2,237,548
For agriculture	29,452	129,825
For other uses	7,612	21,290
	965,371	2,388,663
Calcined:		
Stucco	421,987	2,493,910
Neat plaster	2,069,945	14,324,857
Sanded plaster	207,210	1,414,749
Plaster of Paris (molding and casting, etc.)[1]	173,080	1,542,916
Keenes cement	41,431	674,698
To plate-glass works	18,372	132,203
Plaster board	249,219	4,669,562
Wall board	415,082	11,165,965
Partition tile	231,044	2,102,985
Special tile and block	21,701	280,436
Other uses[2]	63,140	983,510
	3,912,211	39,785,791
Grand total value		42,174,454
1928		
Without calcining:		
To cement mills	969,357	1,802,164
For agriculture	25,668	90,937
For other uses[3]	4,387	8,933
	999,412	1,902,034
Calcined:		
For building purposes—		
Neat plaster	621,119	3,631,518
Sanded plaster	245,617	1,314,480
Fibered plaster	1,549,483	7,677,864
Plaster board and lath	[4] 252,813	4,107,848
Wall board	[5] 459,177	9,046,926
Partition tile	218,560	1,675,153
Roofing tile	26,762	316,659
Special tile and block	5,856	70,222
For insulating	12,776	226,605
For other building purposes[6]	70,758	415,010
For manufacturing uses—		
Plaster of Paris (molding and casting, pottery, foundry, terra cotta, and architectural plaster)	67,067	500,582
Keenes cement	54,020	848,504
To plate-glass works	35,830	196,933
For other manufacturing uses[7]	21,547	105,825
	3,641,385	30,134,129
Grand total value		32,036,163

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[1] Includes dental plaster.
[2] Includes roofing tile, insulating material, etc.
[3] Includes gypsum sold for soil corrective, poultry grits, and road work, and to paint mills.
[4] 284,440,741 square feet.
[5] 559,936,675 square feet.
[6] Includes finished plaster, prepared finishes, board filler, etc.
[7] Includes dental plaster, etc.

Keenes cement sold by producers in the United States, 1919–1928

Year	Manufacturers	Short tons	Value	Year	Manufacturers	Short tons	Value
1919	6	15,395	$200,360	1924	6	30,620	$428,684
1920	6	16,542	246,433	1925	5	36,607	503,397
1921	7	14,430	232,457	1926	4	42,436	603,781
1922	6	21,991	324,316	1927	4	41,431	674,698
1923	5	23,273	323,127	1928	6	54,020	848,504

KETTLES AND KILNS IN OPERATION

The following table gives a comparison of the number and distribution of kettles and kilns (rotary and vertical) in operation in 1927 and 1928. Michigan and Texas each had one operator less in 1928 than in 1927. Michigan, however, had one kettle more in operation, whereas Texas had 17 kettles less. The total daily capacity of the calcining industry in the United States in 1928 was 26,370 short tons, an increase of 204 tons over 1927.

Calcining kettles and kilns reported by gypsum producers in the United States, 1927 and 1928, by States

State	Number of producers	Kettles		Rotary kilns [1]		Total daily capacity (short tons)
		Number	Daily capacity (short tons)	Number	Daily capacity (short tons)	
1927						
Iowa	6	28	4,224			4,224
Kansas	3	(2)	(2)	(2)	(2)	790
Michigan	6	27	2,795			2,795
Nevada	3	13	1,450			1,450
New York	8	23	3,590	10	3,520	7,110
Ohio	3	11	2,360			2,360
Texas	5	40	2,920			2,920
Other States [3]	18	[4] 53	[4] 4,807	[4] 5	[4] 500	4,517
	52	195	22,146	15	4,020	26,166
1928						
California	3	(2)	(2)	(2)	(2)	800
Iowa	6	28	4,204			4,204
Kansas	3	(2)	(2)	(2)	(2)	790
Michigan	5	28	3,100			3,100
Nevada	3	13	1,500			1,500
New York	8	23	3,565	10	3,520	7,085
Ohio	3	11	2,410			2,410
Texas	4	23	2,162			2,162
Other States [3]	16	[4] 56	[4] 5,409	[4] 5	[4] 500	4,319
	51	182	22,350	15	4,020	26,370

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[1] Includes a few vertical kilns reported by one operator in California.

[2] Included under "Other States."

[3] 1927: Arizona, California, Colorado, Montana, New Mexico, Oklahoma, South Dakota, Utah, Virginia, and Wyoming; 1928: Arizona, Colorado, Montana, New Mexico, Oklahoma, South Dakota, Utah, Virginia, and Wyoming.

[4] This figure covers also States entered as "(2)" above.

PRICES AND MARKETS

The price of crude gypsum in 1928 showed a decrease from the price in 1927, falling in some instances to $1.70 per short ton, the lowest for a number of years. The price of ground gypsum fluctuated little during the early part of the year but later reflected the decrease in the price of crude gypsum. The price of calcined gypsum in some sections of the country followed the trend of crude gypsum. For example, at Grand Rapids, Mich., it opened the year at $8 per ton, advanced to $9 in June, and fell to $6 during the latter part of the year. The price of Keenes cement showed some decreases—at Grand Rapids, Mich., from $24.55 per short ton at the beginning of the year to $22.75 in the latter part of the year, and at Gypsum, Ohio, from $27.50 per ton to $24.50.

The prices of some gypsum products in March, June, and December, 1928, appear in the following table.

Gypsum prices, per short ton in carload lots, in 1928[1]

District	Crushed rock			Ground gypsum			Agricultural gypsum			Stucco, calcined			Keenes cement		
	Mar. 3	June 9	Dec. 8	Mar. 3	June 9	Dec. 8	Mar. 3	June 9	Dec. 8	Mar. 3	June 9	Dec. 8	Mar. 3	June 9	Dec. 8
Douglas, Ariz.	-----	-----	-----	-----	-----	-----	$6.00	$6.00	$6.00	$14.50	$14.50	$14.50	$30.00	$30.00	$30.00
Los Angeles, Calif., and Arden, Nev.	$3.00	$3.00	$3.00	$8.00	$8.00	$8.00	8.00	8.00	8.00	10.70	10.70	10.70	------	------	------
San Francisco, Calif.	-----	-----	-----	-----	-----	-----	9.00	9.00	9.00	13.40	13.40	13.40	------	------	------
Centerville, Iowa	3.00	3.00	3.00	10.00	10.00	10.00	15.00	15.00	15.00	10.00	10.00	10.00	------	------	------
Grand Rapids, Mich.	2.75	1.70	2.65	6.00	4.00	4.00	6.00	6.00	6.00	8.00	9.00	6.00	24.55	------	22.75
Gypsum, Ohio	3.00	1.70–3.00	1.70–3.00	4.00	4.00	4.00	6.00	6.00	6.00	7.00	7.00–9.00	7.00–9.00	27.50	24.50	24.50
Port Clinton, Ohio	3.00	3.00	3.00	4.00	4.00	4.00	6.00	6.00	6.00	10.00	10.00	10.00	30.15	30.15	30.15
Seattle, Wash.	6.60	6.10	6.00	10.00	10.50	10.00	10.00	10.50	10.00	13.00	------	13.00	------	------	------
Winnepeg, Manitoba	5.00	5.00	5.00	5.00	5.00	5.00	7.00	7.00	7.00	13.00	13.00	13.00	------	------	------

[1] Rock Products.

IMPORTS AND EXPORTS[2]

IMPORTS

The imports of crude gypsum during 1928 were larger than in any other year in the history of the industry, being in excess of 1,000,000 tons for the first time. Canada was, as usual, the chief source of supply, furnishing 933,478 short tons, valued at $1,242,781, or 91 per cent of the total quantity imported and 93 per cent of the total value. Mexico was the next largest source, supplying 92,363 tons, valued at $92,563. Practically all the rock imported from Canada is destined for manufacture at plants along the Atlantic seaboard, whereas the Mexican rock goes to plants at Long Beach, Calif., and Seattle, Wash. Imports of ground or calcined gypsum decreased from 8,650 short tons, valued at $114,947, in 1927 to 6,907 tons, valued at $99,833, in 1928; the value of the imports of manufactured plaster of Paris decreased from $89,096 in 1927 to $87,314 in 1928; and the imports of Keenes cement fell from 655 short tons, valued at $16,202, in 1927 to 601 tons, valued at $13,729, in 1928. The total value of the imports of gypsum and gypsum products, however, increased from $1,387,826 in 1927 to $1,541,796 in 1928, or 11 per cent.

Figures on imports of gypsum and gypsum products, as recorded by the Bureau of Foreign and Domestic Commerce, are given in the two tables following.

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[2] Figures on imports and exports (unless otherwise indicated) compiled by J. A. Dorsey, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.

Gypsum imported for consumption in the United States, 1919–1928

Year	Crude		Ground or calcined		Manufactured plaster of Paris	Keenes cement		Total value
	Short tons	Value	Short tons	Value		Short tons	Value	
1919	171,733	$211,946	10,415	$126,405	$7,719	187	$5,984	$352,054
1920	282,486	397,942	14,921	179,191	10,282	202	5,338	592,753
1921	266,796	364,318	4,495	55,109	33,072	184	6,836	459,335
1922	409,475	523,939	1,774	32,651	55,116	403	9,636	621,342
1923	448,129	629,203	5,133	77,716	41,317	418	11,543	759,779
1924	519,627	724,864	5,217	70,793	48,059	539	12,042	855,758
1925	634,423	915,888	10,759	140,941	56,724	449	11,294	1,124,847
1926	824,081	1,276,131	7,149	99,058	96,355	578	15,701	1,487,245
1927	828,619	1,167,581	8,650	114,947	89,096	655	16,202	1,387,826
1928	1,028,816	1,340,920	6,907	99,833	87,314	601	13,729	1,541,796

Crude gypsum imported into the United States, 1926–1928, by countries

[General imports]

Country	1926		1927		1928	
	Short tons	Value	Short tons	Value	Short tons	Value
Algeria and Tunisia	1	$10	2,219	$5,710	--------	--------
Belgium	--------	--------	220	543	--------	--------
Canada	728,941	1,044,810	757,785	1,099,131	933,478	$1,242,781
China	--------	--------	--------	--------	2	9
Cuba	4,480	7,000	--------	--------	--------	--------
France	12	64	--------	--------	--------	--------
Germany	(1)	25	1	8	2,951	4,659
Hong Kong	8	281	6	114	6	104
Mexico	85,306	217,043	68,387	62,035	92,363	92,563
Sweden	2,352	1,959	--------	--------	--------	--------
United Kingdom	2,981	4,939	1	40	16	804
	824,081	1,276,131	828,619	1,167,581	1,028,816	1,340,920

[1] Less than ½ ton.

Nine companies in the gypsum industry reported to the Bureau of Mines that they imported 954,000 short tons of crude gypsum in 1928, an increase of 21 per cent compared with 1927. The companies reporting are listed on page 165 and are as follows: Atlantic Gypsum Products Co. (one plant in New Hampshire, one in New York, and one in Pennsylvania), Connecticut Adamant Plaster Co., Higginson Manufacturing Co. (succeeded in 1928 by Universal Gypsum & Lime Co.), Newark Plaster Co., Pennsylvania Gypsum Co. (succeeded November 1, 1928, by Atlantic Gypsum Products Co.), Chas. W. Priddy & Co. (Inc.), Rutland Fire Clay Co., Standard Gypsum Co. (Inc.) (one plant in California and one in Washington), and United States Gypsum Co.

Of the gypsum imported in 1928 (as reported by these companies and shown in the table that follows) 121,339 tons was sold without calcining, an increase of 13 per cent over 1927, and 818,682 tons was sold calcined, an increase of 40 per cent. The value of the gypsum sold without calcining decreased 2 per cent compared with 1927, and the value of that sold calcined increased 23 per cent. The total value of the imported gypsum sold by these nine firms in 1928 was $8,371,188, in comparison with a business of $32,036,163 in domestic gypsum by all producers.

Foreign gypsum sold in the United States, 1927 and 1928, by uses, as reported to th Bureau of Mines by the importers

Use	Short tons	Value
1927		
Without calcining:		
To cement mills	73,239	$239,833
For agriculture	32,278	191,575
For other uses	1,790	26,339
	107,307	457,747
Calcined:		
Stucco	21,233	153,693
Neat plaster	323,865	2,461,297
Sanded plaster	56,562	389,715
Plaster of Paris	138,305	2,418,451
Partition tile	11,350	169,167
Other uses[1]	34,565	839,520
	585,880	6,431,843
Grand total value		6,889,590
1928		
Without calcining:		
To cement mills	86,661	268,040
For agriculture For other uses	34,678	181,206
	121,339	449,246
Calcined:		
For building purposes—		
Neat plaster	126,326	1,594,356
Sanded plaster	89,522	597,029
Fibered plaster	400,311	2,765,455
Plaster board	56,271	661,058
Wall board	66,791	1,219,066
Partition tile	9,993	127,557
Other building purposes[2]	14,530	194,257
For manufacturing uses—		
Plaster of Paris	51,372	731,718
For other manufacturing uses[3]	3,566	31,446
	818,682	7,921,942
Grand total value		8,371,188

[1] Includes dental plaster, plaster board, wall board, roofing tile, and insulating and fireproofing materials.
[2] Includes acoustical and finishing plasters.
[3] Includes filler, dental plaster, etc., and gypsum sold to plate-glass works.

EXPORTS

Exports of gypsum and gypsum products, 1922 to 1928, as classified by the Bureau of Foreign and Domestic Commerce, are shown in the following table.

Gypsum and gypsum products exported from the United States, 1922–1928[1]

Year	Short tons	Value	Year	Short tons	Value
1922	7,673	$178,166	1926	19,610	$576,585
1923	8,815	226,423	1927	18,429	471,106
1924	10,623	358,425	1928	18,788	416,748
1925	16,798	498,616			

[1] Exports of gypsum not separately classified prior to 1922. For 1927 and earlier years the classification reads "Gypsum or plaster, crude, ground, calcined, and manufactures of." For 1928 exports are recorded as follows: "Crude, crushed, or ground," 2,365 short tons, valued at $23,764, and "Plaster, calcined, and manufactures, n. e. s.," 16,423 tons, $392,984.

REVIEW OF GYPSUM INDUSTRY

GYPSUM ENTERPRISES

MANUFACTURERS OF GYPSUM PRODUCTS

Manufacturers of gypsum products in the United States in 1928

[Includes only those manufacturers who mine their own gypsum]

Name and address of operator	Location of mine or plant	Product
American Gypsum Co., Port Clinton, Ohio.	Port Clinton, Ottawa County, Ohio.	Plasters, plaster board, plaster of Paris.
American Keene Cement Co., Sigurd, Utah.	Sigurd, Sevier County, Utah	Keenes cement.
Arizona Gypsum Plaster Co., Douglas, Ariz.	Douglas, Cochise County, Ariz.	Plasters, block and tile.
Beaver Products Co. of Virginia, 100 East Forty-second Street, New York, N. Y.	North Holston, Smyth County, Va.	Plasters, wall board, block and tile, plaster of Paris, Keenes cement.
Best Bros. Keenes Cement Co., Medicine Lodge, Kans.	Sun City, Barber County, Kans.	Plaster of Paris, Keenes cement.
Blue Diamond Co., 1650 South Alameda Street, Los Angeles, Calif.	Mine at Arden, Clark County, Nev.; plant at Los Angeles, Calif.	Plasters.
Cardiff Gypsum Plaster Co., 903 Central Avenue, Fort Dodge, Iowa.	Gypsum, Webster County, Iowa.	Do.
Certain-teed Products Corporation, 100 East Forty-second Street, New York, N. Y.	Fort Dodge, Webster County, Iowa.	Plasters, wall board, block and tile, plaster of Paris, Keenes cement.
	Blue Rapids, Marshall County, Kans.	Plasters, wall board, plaster of Paris, Keenes cement.
	Grand Rapids, Kent County, Mich.	Plasters, wall board, block and tile, plaster of Paris, Keenes cement.
	Acme, Chaves County, N. Mex.	Plasters, plaster and wall board, tile, plaster of Paris, Keenes cement.
	Akron, Erie County, N. Y.	Plasters, wall board, block and tile, plaster of Paris, Keenes cement.
	Gypsum, Ottawa County, Ohio.	Plasters, wall board, plaster of Paris, Keenes cement.
	Acme, Grady County, Okla.	Plasters, plaster and wall board, plaster of Paris, Keenes cement.
	Acme, Hardeman County, Tex.	Plasters, wall board, block and tile, plaster of Paris, Keenes cement.
	Laramie, Albany County, Wyo.	Plasters, wall board, plaster of Paris, Keenes cement.
Colorado Portland Cement Co., Portland, Colo.	Coaldale, Fremont County, Colo.	Plasters.
Dakota Plaster Co., Rapid City, S. Dak.	Black Hawk, Meade County, S. Dak.	Plasters, wall board.
Ebsary Gypsum Co. (Inc.), Scottsville, N. Y.	Wheatland, Monroe County, N. Y.	Plasters, wall board, block and tile.
Empire Gypsum Co. (Inc.), 319 Cutler Building, Rochester, N. Y.	Garbutt, Monroe County, N. Y.	Plasters, block and tile.
Federal Gypsum Co., Centerville, Iowa.	Centerville, Appanoose County, Iowa.	Plasters, block and tile, plaster of Paris.
Grand Rapids Plaster Co., 1204 Grand Rapids Savings Bank Building, Grand Rapids, Mich.	Grand Rapids and Grandville, Kent County, Mich.	Plasters.
Jumbo Plaster & Cement Co., Sigurd, Utah.	Sigurd, Sevier County, Utah	Do.
Michigan Gypsum Co. (plaster department), Grand Rapids, Mich.	Grand Rapids, Kent County, Mich.	Do.
National Gypsum Co., 409 Jackson Building, Buffalo N. Y.	National City, Iosco County, Mich.	Plasters, wall board, plaster of Paris.
	Clarence Center, Erie County, N. Y.	Do.
Nephi Plaster & Mfg. Co., 907 Continental Bank Building, Salt Lake City, Utah.	Near Nephi, Juab County, Utah.	Plasters, plaster of Paris, Keenes cement.
Niagara Gypsum Co., 597 Michigan Street, Buffalo, N. Y.	Oakfield, Genesee County, N. Y.	Plasters, plaster and wall board, block and tile.
Oakfield Gypsum Products Corporation, Oakfield, N. Y.	Alabama, Genesee County, N. Y.	Plasters.
Pacific Portland Cement Co., Consolidated, 111 Sutter Street, San Francisco, Calif.	Plaster City, Imperial County, Calif.	Plasters, block and tile, plaster of Paris.
	Near Gerlach, Washoe County, Nev.	Do.

Manufacturers of gypsum products in the United States in 1928—Continued

Name and address of operator	Location of mine or plant	Product
Standard Gypsum Co. (Inc.), 1112 Phelan Building, San Francisco, Calif.	Ludwig, Lyon County, Nev.	Plasters.
Texas Cement Plaster Co., 701-715 Petroleum Building, Oklahoma City, Okla.	Fisher County, near Hamlin, Tex.	Plasters, wall board, block and tile, plaster of Paris.
Three Forks Portland Cement Co. (Colorado Portland Cement Co.), 507 Ideal Building, Denver, Colo.	Hanover, Fergus County, Mont.	Plasters.
United States Gypsum Co., 300 West Adams Street, Chicago, Ill.	Midland, Riverside County, Calif.	Plasters, plaster and wall board.
	Loveland, Larimer County, Colo.	Do.
	Fort Dodge, Webster County, Iowa.	Plasters, plaster and wall board, block and tile.
	Blue Rapids, Marshall County, Kans.	Plasters.
	Alabaster, Iosco County, Mich.	Do.
	Grand Rapids, Kent County, Mich.	Do.
	Heath, Fergus County, Mont.	Plasters, block and tile.
	Arden, Clark County, Nev.	Do.
	Gypsum, Ottawa County, Ohio.	Plasters, plaster and wall board, block and tile.
	Eldorado, Jackson County, Okla.	Plasters, plaster and wall board.
	Southard, Blaine County, Okla.	Plasters, plaster and wall board, Keenes cement.
	Oakfield, Genesee County, N. Y.	Plasters, plaster and wall board, block and tile.
	Piedmont, Meade County, S. Dak.	Plasters.
	Sweetwater, Nolan County, Tex.	Plasters, plaster and wall board.
	Plasterco, Washington County, Va.	Do.
	Laramie, Albany County, Wyo.	Do.
Universal Gypsum & Lime Co., 1535 Conway Building, Chicago, Ill.	Fort Dodge, Webster County, Iowa.	Plasters, plaster and wall board, block and tile.
	Akron, Erie County, N. Y.	Plasters, plaster and wall board.
	Rotan, Fisher County, Tex.	Do.
Wasem Plaster Co. Warden Apartments, Fort Dodge, Iowa.	Fort Dodge, Webster County, Iowa.	Plasters, block and tile, plaster of Paris.

MINERS ONLY

Miners of gypsum (selling only uncalcined gypsum) in the United States in 1928

Name and address of operator	Location of mine
Atlas Gypsum Corporation, 25 Broadway, New York, N. Y.	Clarence Center, Erie County, N. Y.
Atlas Portland Cement Co. (of Kansas), Independence, Kans.	Watonga, Blaine County, Okla.
Hawkeye Gypsum Products Co., Fort Dodge, Iowa	Fort Dodge, Webster County, Iowa.
Lycoming Calcining Co., 120 West Fourth Street, Williamsport, Pa.	Garbutt, Monroe County, N. Y.
Phoenix Gypsum Co. (Inc.), Basom, N. Y.	Alabama, Genesee County, N. Y.
Regan Bros., Mason, Nev.	Mason, Lyon County, Nev.

IMPORTERS OF CRUDE GYPSUM

Gypsum operators importing crude gypsum into the United States in 1928

Name and address of operator	Location of mine producing gypsum	Location of plant receiving imported gypsum	Product
Atlantic Gypsum Products Co., 40 Central St., Boston, Mass.	Cheticamp, Nova Scotia.	Portsmouth, N. H.	Plasters, plaster and wall board, block and tile, plaster of Paris.
	do	New York. N. Y.	Plasters, plaster of Paris.
	Ingonish, Nova Scotia.	Chester, Pa.[1]	Plasters, block and tile, plaster of Paris.
Connecticut Adamant Plaster Co., New Haven, Conn.	Cheverie, Hants County, Nova Scotia.	New Haven, Conn.	Plasters, plaster of Paris.
Higginson Manufacturing Co., Newburgh, N. Y.[2]	Windsor, Nova Scotia.	Newburgh, N. Y.	Plasters, plaster of Paris, etc.
Newark Plaster Co., 30 Church St., New York, N. Y.	Ottawa Brook, Nova Scotia.	Newark, N. J.	Block and tile, plaster of Paris.
Pennsylvania Gypsum Co., Chester, Pa.	Ingonish, Nova Scotia.	Chester, Pa.[1]	Plasters, block and tile.
Chas. W. Priddy & Co. (Inc.), Norfolk, Va.	Walton, Nova Scotia	Norfolk, Va.	Land plaster.
Rutland Fire Clay Co., Rutland, Vt.	Baddeck, Nova Scotia.	Rutland, Vt.	Plasters.
Standard Gypsum Co. (Inc.), 1112 Phelan Building, San Francisco, Calif.	San Marcos Island, Lower California, Mexico.	Long Beach, Calif.	Plasters, plaster and wall board, plaster of Paris.
	do	Seattle, Wash.	Do.
United States Gypsum Co., 300 West Adams St., Chicago, Ill.	Windsor, Nova Scotia	Boston, Mass.	Do.
	do	New Brighton, N. Y.	Plasters, plaster and wall board, etc.

[1] Atlantic Gypsum Products Co. succeeded Pennsylvania Gypsum Co. at Chester, Pa., on Nov. 1, 1928.
[2] Succeeded by Universal Gypsum & Lime Co., January, 1928.

NEW COMPANIES AND CONSOLIDATIONS, ETC.

Two new gypsum-producing companies entered the field during the year, the Victor Plaster Co. (Inc.), at Victor, N. Y., and the Atlas Portland Cement Co. (of Kansas), at Watonga, Okla. The former company completed a new hoist and a modern plant for the crushing of gypsum rock and will start operations in the spring of 1929. The plant is about 1½ miles east of Victor and is on the main line of the Lehigh Valley Railroad. The latter company opened up a rock quarry and crushing plant at Watonga, Blaine County, Okla.

The most notable consolidation during 1928 was that of the Certain-teed Products Corporation, of New York, N. Y., and the Beaver Products Co. (Inc.), of Buffalo, N. Y., in a $47,000,000 merger. The United States Gypsum Co. opposed the merger on the grounds that the acquisition of the assets of the Beaver Products company by the Certain-teed Products Corporation would leave the former without assets to carry out the provisions of its licensing contract relative to the manufacture of plaster board; the merger was eventually consummated on a basis supposed to be satisfactory to both the Certain-teed Products Corporation and the United States Gypsum Co.

Early in 1928 the Universal Gypsum & Lime Co., Chicago, Ill., acquired the plaster mill at Newburgh, N. Y., and 270 acres of gypsum ground in Nova Scotia, Canada, formerly owned by the Higginson Manufacturing Co., of Newburgh, and an interest in the lime plant of that company at Ossining, N. Y.

The National Gypsum Co., Buffalo, N. Y., entered the lime business by taking over the plant and business of the Luckey Lime & Supply Co., Luckey, Ohio.

The Atlantic Gypsum Products Co. and the Canada Cement Co. combined their Canadian gypsum operations, whereby the Atlantic Gypsum Products Co. took over all the gypsum operations of the Canada Cement Co., including the plant of the Pennsylvania Gypsum Co., at Chester, Pa. The Atlantic Gypsum Products Co. will supply the Canada Cement Co. with all the gypsum required for all its Portland cement.

The United States Gypsum Co. purchased the Heath, Mont., plant of the Northwest Gypsum Products Co. and the Laramie, Wyo., plant of the Overland Cement Plaster Co.

The Certain-teed Products Corporation acquired a gypsum deposit in Colorado.

The Beaver Products Co. (Inc.) plant at Acme, Tex., taken over in the early part of 1928 by the Certain-teed Products Corporation, was closed down April 1, 1928.

A development of importance during 1928 was the liquidation of the retail establishments of the United States Gypsum Co. at Hartford, Conn., Boston, Mass., and Buffalo, N. Y. These disposals mark the end of the company's activity as a retailer.

NEW PLANTS AND PLANT INCREASES

Many companies carried out extensive plant improvements and enlargements during 1928, but, as has been previously noted, these changes were not made to provide increased capacity for production but were in the nature of readjustments within the industry and to enable the older plants better to compete with newer and more up-to-date plants.

The Atlantic Gypsum Products Co. completed its New York City plant during 1928. This plant occupies the same site as the old plant destroyed by fire early in September, 1927.

The United States Gypsum Co.'s new Boston plant started operations with the arrival of the first shipload of gypsum rock on November 14, 1928. Rock for this plant and for the plant on Staten Island, New York, is transported in the company's own vessels—the *Gypsum King*, *Gypsum Queen*, *Gypsum Prince*, and the later addition to the fleet, the *Gypsum Princess*—all specially designed and built for handling gypsum cargoes. The new boat is 347 feet long, with a 52-foot beam, and has a gross tonnage of 6,200 tons.

Another new plant of the United States Gypsum Co., that at Midland, Calif., started operation during 1928. This is only a calcining plant and may be designed to supply all of the company's shipments to southern California markets; if so, the company's plant at Arden, Nev., will probably be abandoned. Plans for the erection of a wall-board plant at Midland, Calif., are said to be undetermined.

The outstanding plants still under construction at the end of the year were the three new plants of the United States Gypsum Co. at Detroit, Philadelphia, and at East Chicago, Ind. The total investment in these plants will be between $8,000,000 and $9,000,000. The erection of gypsum-calcining plants in large cities has been made possible within the past few years by the advancement made in air-separation and dust-arrester equipment.

The Ebsary Gypsum Co. (Inc.), Scottsville, N. Y., began to operate its new wall-board plant at Wheatland, in which is installed perhaps the most modern dryer in the industry.

The National Gypsum Co. installed a new hammer mill and other additions to its National City, Mich., plant.

Before its acquisition by the Atlantic Gypsum Products Co. the Pennsylvania Gypsum Co. authorized the expenditure of $200,000 for alterations and improvements at the Chester, Pa., plant.

The Standard Gypsum Co. (Inc.) installed a hammer mill for a secondary crusher in its Long Beach, Calif., plant. It also installed at San Marcos Island, Lower California, Mexico, a new 365-horsepower Diesel engine directly connected to a 300-kilowatt generator; this installation will insure the company ample power for all its quarry and loading operations. The company also made considerable shipments of crude rock from the San Marcos deposits to Japan. To insure an ample supply of crude rock for quick loading of the boats the stockpile capacity was increased to 20,000 tons—an increase of about 4,000 tons.

At Alabaster, Mich., the United States Gypsum Co. completed an aerial tramway 1¼ miles long from the shore line out into the lake. This tram was built as a part of the loading equipment to be used for loading crude gypsum for water transportation to the new Detroit and East Chicago plants.

During 1928, the Best Bros. Keenes Cement Co. doubled the capacity of its plant and made further extensions, both to the quarries and mills, which when completed will result in a further increase of nearly 100 per cent. Two additional rotary kilns and coolers are planned for the mills at Medicine Lodge, Kans., and a 2-story addition, 72 feet wide and 60 to 80 feet long, will be built on the east end of No. 3 mill, replacing the old No. 3 power house.

NEW PRODUCTS

There were very few new gypsum products brought out in 1928 besides those developed by the United States Gypsum Co., among which were waterproof cold-water paint called Texolite, and Em-Bel-Lo, a plaster paint suitable as a color carrier or texture base. This company also developed a method of soundproofing, which is essentially a method of construction that interposes a "shock-absorbing" medium between the finished surfaces. The product is in the nature of a porous furring and is used for ceiling, wall, sub-ceiling, or floor insulation purposes. Moreover, the company added a full line of metal lath to its already wide line of plastering materials.

The introduction of the "talkies" in the moving-picture industry has led to the development of a new and interesting use for gypsum as an insulator of sound. The Fox Movietone Co., at Hollywood, Calif., has a plant representing an investment of $10,000,000 and comprising 17 buildings of reinforced concrete; two of these are huge buildings housing the soundproof stages.[3] These soundproof stages are the most interesting part of the project. Two gigantic concrete shells are anchored 20 feet underground, and each house has two soundproof stages. Each stage is 100 feet long, 75 feet wide, and 30 feet high and resembles a huge concrete box. The stages are separated from the outer buildings by a dead-air space, and the sides of the concrete wall facing the air spaces are lined with a layer of cork and a layer of felt. The features that contribute most toward rendering the stages soundproof are the hanging walls and ceilings. The stages are literally hung from the roof to the floor level by means of steel rods suspended vertically. The same system is employed for the ceiling but gypsum slabs are used. The gypsum slabs, which are 30 inches square and about 3 inches thick, are built on a foundation of expanded metal and have steel rods running through them ending in hooks at the sides. Suspended horizontally on heavy wires from the roof trusses and joists are channel irons which run the full width of the stages at intervals corresponding to the width of the gypsum blocks. The slabs are hung on these channel irons, and the interstices are filled with gypsum from above and plaster from below. The under surface is covered with felt and cork. The ceiling of each stage requires approximately 62½ tons of gypsum slabs and the four stages call for the use of 30,000 square feet of this material with a total weight of 250 tons.

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[3] Rock Products, vol. 31, No. 26, Dec. 22, 1928, p. 141.

TECHNICAL DEVELOPMENTS

Several of the newer plants, especially those of the United States Gypsum Co., are using rotary kilns for calcination—quite a significant development. However, the extended use of pressed-steel bottoms (which have eliminated excessive repairs to the older cast-iron bottoms) has given the older kettle-calcination process a grip that will be difficult to overcome, especially in plants of small capacity or with moderate working capital.[4]

The advances made in dust collection in connection with calcination processes are noteworthy and have made possible the operation of calcining plants in the larger cities. The excessive dust formation during calcination has in several instances caused difficulty in securing building permits for the erection of calcining plants within city limits. Dust collection from other places in the mill presents no special problem. At the kettles several methods have been developed—one by William Senseman, of Los Angeles, who is connected with the Raymond Bros. Impact Pulverizer Co.; another by the W. W. Sly Manufacturing Co.; and still another by the Dust Recovering & Conveying Co. These methods seem to give satisfactory results.

Rotary crushers for gypsum are apparently being replaced by hammer mills. The latter, according to one operator, give a very satisfactory feed material for Raymond mills and have corrected somewhat the troubles due to tramp iron.

Fuller-Kinyon pumps continue to gain favor in the handling of both hot and cold plasters. At the Schumacher plant in Los Angeles they are successfully handling comparatively cold plasters, and the newer plants are incorporating this feature in their designs.

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[4] Rock Products, vol. 31, No. 26, Dec. 22, 1928, p. 141.

Buhr mills have been in general use in the past for grinding calcined gypsum. Owing, however, to the power required, the maintenance cost, and the large number of units necessary for a plant of any considerable capacity, this type of mill has been replaced in a number of gypsum plants by tube mills of the Hardinge type.

A new method of calcining gypsum is now being developed by the Raymond Bros. Impact Pulverizer Co.; it is a step further in the application of their mills for grinding and drying in the same operation. It has been common practice to combine in these mills the process of drying and of grinding rock products that are physically water-wet, but removing chemically combined water and grinding in the same operation is novel. So far results in an experimental plant have been very satisfactory and plaster of exceptional uniformity has been produced.

The process consists essentially of pulverizing gypsum, the mill being surrounded with a suitable fire box heated by oil, gas, or powdered-coal fuels. The grinding operation and the calcination are thus conducted simultaneously, and the calcined plaster is removed from the mill by the usual Raymond mill fan and air-separation system. The bearings of this mill are water or oil cooled and extend outside the fire box.

The results obtained in a small mill that produces 1,500 pounds per hour are reported to be so satisfactory that the Raymond Bros. company is ready to cooperate with any of the gypsum-plaster producers in working out the process on a larger scale. The Standard Gypsum company is at present assisting the engineers of the Raymond Bros. company in perfecting the process.

Owing to low installation costs and the simplicity of this process, its commercial development might mean that many small-products manufacturers who now purchase their plaster might consider calcining their own material, provided the crude gypsum could be easily obtained.

SYNTHETIC GYPSUM

The use of synthetic gypsum in the United States is becoming more and more important, especially in regions devoid of gypsum deposits.

The five plants in four States produced 82,309 short tons of synthetic gypsum during 1928, practically all of which was used for the manufacture of tile and block. The names and addresses of these companies are: United States Phosphoric Products Corporation, Tampa, Fla.; Calumet Chemical Co., Joliet, Ill.; Structural Gypsum Corporation, Linden, N. J.; Warner Chemical Co., New York, N. Y. (plant at Carteret, N. J.); and the Rumford Chemical Works, Providence, R. I.

The United States Phosphoric Products Corporation started operations during the early part of the year at East Tampa, Fla., manufacturing gypsum block from synthetic gypsum. This gypsum is a by-product of the manufacture of "superphosphate" from Florida phosphate, and the new plant was built to utilize this material. The company has manufactured several thousand tons of synthetic gypsum, and is producing at the rate of 400 tons a day. The plant is expected shortly to have a daily capacity of about 6,000 blocks.

The Aluminum Ore Co., of East St. Louis, Ill., completed a plant during the year for the manufacture of gypsum products, utilizing an anhydrous calcium sulphate residue from the manufacture of hydrofluoric acid from fluorspar. The process used includes a method of hydrating the waste products, containing some free H_2SO_4, to gypsum, filtering the hydrated material, and calcining the filter cake in standard kettles. The company has only a limited supply—about 50 tons per day—of this material, and intends to seek a local market.

WORLD PRODUCTION

The following table shows the output of gypsum by various countries from 1924 to 1928, as far as statistics are available.

World production of gypsum, 1924–1928, by countries, in metric tons

[Compiled under supervision of L. M. Jones, of the Bureau of Mines]

Country	1924	1925	1926	1927	1928
Algeria	54,474	72,842	74,070	74,512	77,574
Argentina[1]	32,014	42,775	36,121	52,111	21,217
Australia:					
New South Wales	2,709	301	830	1,506	12,761
South Australia	66,744	73,436	66,666	95,356	93,004
Victoria	13,481	14,751	10,381	21,169	10,728
Western Australia	4,305	3,109	3,981	6,782	4,282
Austria[2]	60,000	60,000	58,000	40,000	45,000
Canada	638,413	640,335	844,760	983,677	(3)
Chile	5,690	8,446	6,991	8,245	(4)
China[5]	5,123	7,097	3,781	2,470	3,266
Cuba	(4)	(4)	(4)	(4)	23,950
Cyprus[5]	14,525	24,510	19,445	14,010	11,226
Estonia	7,074	5,060	4,828	12,172	7,982
France	2,326,838	2,330,640	2,177,950	(6)	(4)
Germany:					
Bavaria	43,331	57,884	45,690	59,772	54,482
Prussia	442	405	262	538	(4)
Greece	22,207	10,060	9,723	2,014	(4)
India, British	38,735	36,826	35,026	38,717	(4)
Italy	599,940	673,532	655,548	673,931	578,487
Japan	43,093	58,537	264,989	75,498	(4)
Latvia[5]	4,305	12,355	21,616	24,463	28,020
Luxemburg	29,990	24,951	33,984	7,848	2,506
New Caledonia	(6)	15,000	20,000	10,000	15,000
Peru	12,272	14,644	11,706	10,050	15,635
Philippine Islands	2,839	2,000	387	----------	----------
Poland	(4)	(4)	17,676	(4)	(4)
Rumania	20,782	53,845	44,316	77,724	47,785
Russia[7]	53,559	169,023	291,598	283,002	(4)
Spain	619,049	589,431	731,369	911,346	1,054,018
Sweden	(6)	128	137	(6)	(4)
Tunisia	20,000	11,600	13,070	16,000	16,000
Union of South Africa	9,219	7,237	11,389	15,430	14,871
United Kingdom:					
Great Britain	377,248	420,952	472,567	514,364	644,831
Northern Ireland	421	231	90	113	17
United States	4,574,572	5,151,242	5,112,359	4,850,590	4,628,659
Yugoslavia[8]	----------	----------	620	1,063	1,170
	9,700,000	10,600,000	11,100,000	11,100,000	(4)

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[1] Railroad shipments.

[2] Estimate furnished by Bundesministerium für Handel und Verkehr.

[3] Data for crude gypsum mined not available. Shipments of crude (lump, crushed, and ground) and calcined gypsum amounted to 1,093,919 metric tons.

[4] Data not available.

[5] Exports.

[6] Data not available; estimate included in world total.

[7] Year ended Sept. 30.

[8] Serbia only.

CANADA

PRODUCTION

The production (shipments) of gypsum in Canada in 1928 amounted to 1,205,846 short tons, valued at $3,622,007, as follows: Lump or run-of-mine, 24,589 tons, valued at $52,215; crushed, 995,297 tons, valued at $1,709,423; fine ground, 9,549 tons, valued at $54,407; and calcined, 176,411 tons, valued at $1,805,962.

The following tables set forth these figures in comparison with those for previous years.

Crude (lump, crushed, and ground) and calcined gypsum shipped in Canada, 1920–1928, by classes[1]

Year	Crude					
	Lump and crushed			Ground		
	Short tons	Value		Short tons	Value	
		Total	Average per ton		Total	Average per ton
1920	310,821	$604,105	$1.94	6,615	$46,584	$7.04
1921	262,349	518,747	1.98	7,020	24,029	3.42
1922	418,831	688,357	1.64	5,769	35,880	6.22
1923	450,313	837,648	1.86	7,452	45,719	6.14
1924	520,880	946,976	1.82	5,478	31,882	5.82
1925	579,378	1,018,947	1.76	5,993	35,843	5.98
1926	728,395	1,228,428	1.69	5,874	36,813	6.27
1927	890,763	1,594,558	1.79	7,065	42,633	6.03
1928	1,019,886	1,761,638	1.73	9,549	54,407	5.70

Year	Calcined			Total		
	Short tons	Value		Short tons	Value	
		Total	Average per ton		Total	Average per ton
1920	111,708	$1,243,302	$11.13	429,144	$1,893,991	$4.41
1921	117,181	1,242,762	10.61	386,550	1,785,538	4.62
1922	134,665	1,436,661	10.67	559,265	2,160,898	3.86
1923	120,536	1,359,733	11.28	578,301	2,243,100	3.88
1924	119,658	1,229,250	10.27	646,016	2,208,108	3.42
1925	154,952	1,335,101	8.62	740,323	2,389,891	3.23
1926	149,459	1,505,572	10.07	883,728	2,770,813	3.14
1927	165,289	1,613,824	9.76	1,063,117	3,251,015	3.06
1928	176,411	1,805,962	10.24	1,205,846	3,622,007	3.00

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[1] Annual Report on the Mineral Production of Canada, Ottawa.

Gypsum trade in Canada, 1927 and 1928[1]

	1927		1928	
	Short tons	Value	Short tons	Value
Production (shipments):				
By classes—				
Crude—				
Lump or run-of-mine	225, 264	$371, 488	24, 589	$52, 215
Crushed	665, 499	1, 223, 070	995, 297	1, 709, 423
Fine ground	7, 065	42, 633	9, 549	54, 407
Calcined	165, 289	1, 613, 824	176, 411	1, 805, 962
	1, 063, 117	3, 251, 015	1, 205, 846	3, 622, 007
By Provinces—				
Nova Scotia	829, 438	1, 512, 015	971, 736	1, 764, 262
New Brunswick	85, 293	524, 550	74, 783	500, 502
Ontario	83, 998	500, 688	85, 811	553, 271
Manitoba	39, 895	512, 008	51, 285	609, 039
British Columbia	24, 493	201, 754	22, 231	194, 933
	1, 063, 117	3, 251, 015	1, 205, 846	3, 622, 007
Imports:				
Crude gypsum	1, 092	42, 741	1, 097	40, 312
Ground, not calcined	111	2, 996	256	7, 379
Calcined	7, 016	101, 823	10, 563	142, 550
	8, 219	147, 560	11, 916	190, 241
Exports:				
Crude gypsum	588, 808	959, 858	824, 536	1, 240, 987
Plaster of Paris, prepared wall plaster	6, 556	113, 049	8, 232	140, 946
	595, 364	1, 072, 907	832, 768	1, 381, 933

[1] Annual Report on the Mineral Production of Canada, Ottawa.

In 1928, as usual, Nova Scotia accounted for the larger part of the production of gypsum in Canada. The Nova Scotian output in 1928 aggregated 971,736 short tons, valued at $1,764,262, or 81 per cent of the total quantity produced in Canada and 49 per cent of its value. The difference between the percentage of the total quantity and that of the value is due to the fact that most of the crude rock produced in Nova Scotia is destined for further fabrication in the United States and the values are those shown by the shipping companies involved.

New Brunswick, at one time the second largest producer in Canada, is now surpassed by Ontario as a result of the withdrawal of American companies that formerly operated in New Brunswick and of the rapidly growing demand in Canada for calcined gypsum products. These products are produced largely in Ontario from Nova Scotian crude rock. Ontario's production of gypsum in 1928 amounted to 85,811 short tons, valued at $553,271, or 7 per cent of the total quantity produced in Canada and 15 per cent of its value, compared with New Brunswick's production of 74,783 tons, valued at $500,502, or 6 per cent of the total quantity and 14 per cent of its value.

The gypsum industry in Manitoba and British Columbia has been growing rapidly during recent years. The output of Manitoba amounted in 1928 to 51,285 short tons, valued at $609,039, and that of British Columbia to 22,231 tons, valued at $194,933. The shares of these two provinces in the total Canadian production in 1928 were as follows: Manitoba, 4 per cent of the quantity and 17 per cent of the value; British Columbia, 2 per cent of the quantity and 5 per cent of the value.

The following table shows the shipments of gypsum in Canada from 1920 to 1928, by Provinces.

Gypsum shipped in Canada, 1920–1928, by Provinces [1]

Year	Nova Scotia		New Brunswick		Ontario	
	Short tons	Value	Short tons	Value	Short tons	Value
1920	260, 661	$573, 752	49, 405	$428, 183	74, 707	$404, 162
1921	206, 831	511, 883	54, 030	360, 220	84, 790	433, 053
1922	332, 404	580, 148	82, 462	517, 668	110, 227	621, 668
1923	341, 705	747, 934	104, 740	564, 680	99, 958	542, 317
1924	441, 752	915, 845	86, 738	476, 804	88, 121	467, 097
1925	551, 230	1, 070, 408	71, 745	408, 917	82, 020	491, 833
1926	678, 107	1, 187, 918	59, 546	468, 411	89, 987	496, 059
1927	829, 438	1, 512, 015	85, 293	524, 550	83, 998	500, 688
1928	971, 736	1, 764, 262	74, 783	500, 502	85, 811	553, 271

Year	Manitoba		British Columbia		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1920	44, 371	$487, 894			429, 144	$1, 893, 991
1921	40, 859	480, 282	40	$100	386, 550	1, 785, 538
1922	34, 072	440, 914	100	500	559, 265	2, 160, 898
1923	31, 575	386, 554	323	1, 615	578, 301	2, 243, 100
1924	29, 375	348, 212	30	150	646, 016	2, 208, 108
1925	35, 088	417, 868	240	865	740, 323	2, 389, 891
1926	35, 172	461, 461	20, 916	156, 964	883, 728	2, 770, 813
1927	39, 895	512, 008	24, 493	201, 754	1, 063, 117	3, 251, 015
1928	51, 285	609, 039	22, 231	194, 933	1, 205, 846	3, 622, 007

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[1] Annual Report on the Mineral Production of Canada, Ottawa.

EXPORTS AND IMPORTS

The larger part of the production of crude gypsum in Canada, especially that from Nova Scotia, is destined for calcining plants in the United States. Most of these plants, which are along the Northern Atlantic seaboard, rely entirely upon crude gypsum imported from Canada.

In 1928 Canada exported 824,536 short tons of gypsum, valued at $1,240,987, or 68 per cent of the total quantity produced and 34 per cent of its value. Virtually all of the gypsum exported came from Nova Scotia. During 1928 there were six American concerns operating in Nova Scotia and shipping their entire output to the United States. Another American firm, which heretofore has worked a deposit on Cape Breton Island and shipped the output to its plant in the United States, did not operate in 1928. In the past American concerns have operated in the vicinity of Hillsborough and Albert in New Brunswick.

The following tables show the foreign trade of Canada in crude and calcined gypsum products.

Crude gypsum exported from Canada, 1920–1928 [1]

Year	Short tons	Value	Per cent of total quantity shipped	Year	Short tons	Value	Per cent of total quantity shipped
1920	244,428	$413,522	57	1925	533,616	$861,468	72
1921	230,011	417,502	60	1926	668,064	1,069,123	76
1922	325,354	505,464	58	1927	588,808	959,858	55
1923	397,329	578,859	69	1928	824,536	1,240,987	68
1924	472,236	747,829	73				

[1] Annual Report on the Mineral Production of Canada, Ottawa.

Gypsum imported into Canada, 1920–1928 [1]

Year	Crude gypsum		Ground gypsum		Plaster of Paris	
	Short tons	Value	Short tons	Value	Short tons	Value
1920	2,294	$35,477	118	$3,966	2,822	$48,859
1921	2,952	31,303	41	2,427	2,635	42,325
1922	2,872	21,040	148	5,592	3,657	49,015
1923	3,654	39,336	78	3,253	3,617	54,591
1924	3,252	63,156	102	2,174	3,969	62,770
1925	4,433	66,064	119	3,858	4,369	66,386
1926	933	32,442	209	6,846	5,156	79,853
1927	1,092	42,741	111	2,996	7,016	101,823
1928	1,097	40,312	256	7,379	10,563	142,550

[1] Annual Report on the Mineral Production of Canada, Ottawa.

NOTES ON CANADIAN PLANTS

The largest manufacturer of gypsum products in Canada is the Canada Gypsum & Alabastine Co. (Ltd.), in Ontario. This company is a combination of the Canada Gypsum & Alabastine Co., the Ontario Gypsum Co. (Ltd.), the Nova Scotia Coal & Gypsum Co. (Ltd.), and the Toronto Builders Supplies (Ltd.). The merger took place in 1927.[5] In March, 1928, a bond issue was offered the public in order to finance the purchase of the business and property of the Manitoba Gypsum Co. (Ltd.), of Winnipeg, and its subsidary, the British Columbia Gypsum Co. (Ltd.), of Port Mann, British Columbia.

The Canada Cement Co. sold its gypsum business in 1928 to the Atlantic Gypsum Products Co., an American concern that has fabricating plants at New York City and at Portsmouth, N. H. The Pennsylvania Gypsum Co., a subsidiary of the Canada Cement Co., was also taken over by the Atlantic Gypsum Products Co. at the same time. The Canada Cement Co. now purchases all its requirements of crude gypsum for its cement plants from the Atlantic Gypsum Products Co.

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[5] Canadian Chemistry and Metallurgy, vol. 13, No. 3, March, 1929, p. (72) 21

LIME

By A. T. Coons

SUMMARY

Sales of lime in 1928 by producers in the United States amounted to 4,458,412 short tons, valued at $36,449,635, an increase of 1 per cent in quantity but a decrease of 6 per cent in value compared with 1927. Conditions in the lime industry during 1928 were unsettled, with general decreases in price and considerable variations in demand. Lime for construction (1,986,465 tons, valued at $17,706,420) was affected most by the unsettled conditions, and showed a decrease of 7.6 per cent in quantity and 15.5 per cent in value from 1927. Lime for chemical use (2,138,037 tons, valued at $16,455,657) increased 10 per cent in quantity and 6.6 per cent in value, and lime for agriculture (333,910 tons, valued at $2,287,558) increased 3 per cent in quantity and 2 per cent in value. Ohio and Pennsylvania, the largest producing States, showed increases of 2.6 and 2.5 per cent, respectively, in quantity. Of the other States producing considerable quantities of lime Maine, Michigan, Missouri, Tennessee, and West Virginia increased in output, and Alabama, Illinois, Indiana, Massachusetts, Virginia, and Wisconsin decreased.

The total number of plants that reported operations in 1928 was 411, six less than in 1927. Other than a noticeable increase in the number of intermittently operated small field kilns reporting from Pennsylvania, only eight States showed a larger number of operating plants than in 1927 and except for Maryland, Pennsylvania, and Virginia, where the additional plants reporting were small intermittently operated field kilns, the increase was limited to one plant in a State, whereas one to three plants were idle or abandoned in 18 States. Labor conditions and wages at the plants were about the same as in 1927, the cost of materials was somewhat lower, and prices also were lower. The average value per ton at the plant of the total lime sold decreased from $8.75 in 1927 to $8.18 in 1928. The average value per ton for building lime ($8.91) was 85 cents less than in 1927, for chemical lime ($7.70) was 24 cents less, and for agricultural lime ($6.85) was 8 cents less. Except for the output of one firm in Alabama the accompanying tables do not include lime that is not a commercial product but is burned, for use in manufacturing, from stone either quarried or purchased by the manufacturer. This stone is reported to the Bureau of Mines as raw limestone and is included in the statistics on stone; it is used mainly by alkali works, carbide works, sugar refineries, paper mills, smelters, and other metallurgical plants.

PRODUCTION

Lime sold by producers in the United States, 1919–1928

Year	Number of plants in operation	Short tons	Value [1]	
			Total	Average
1919	539	3, 330, 347	$29, 448, 553	$8. 84
1920	515	3, 570, 141	37, 543, 840	10. 52
1921	520	2, 532, 153	24, 895, 370	9. 83
1922	530	3, 639, 617	33, 255, 039	9. 14
1923	467	4, 076, 243	39, 993, 652	9. 81
1924	450	4, 072, 000	39, 596, 423	9. 72
1925	450	4, 580, 823	42, 609, 141	9. 30
1926	435	4, 560, 398	41, 566, 452	9. 11
1927	417	4, 414, 932	38, 638, 413	8. 75
1928	411	4, 458, 412	36, 449, 635	8. 18

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[1] The value given represents the value of bulk lime f. o. b. at point of shipment and does not include cost of barrel or package.

Lime sold by producers in the United States, 1927–28, by States

State	1927			1928		
	Number of plants in operation	Short tons	Value	Number of plants in operation	Short tons	Value
Alabama	10	206, 010	$1, 566, 287	11	192, 364	$1, 407, 232
Arizona	3	41, 859	390, 074	2	36, 244	343, 167
Arkansas	4	35, 375	307, 335	5	40, 438	339, 624
California	8	64, 934	708, 010	9	60, 751	617, 472
Colorado	4	11, 900	125, 875	3	8, 114	88, 775
Connecticut	6	53, 304	608, 550	6	48, 152	529, 936
Florida	3	5, 317	59, 491	3	4, 748	50, 086
Georgia	1	13, 533	99, 604	1	12, 890	83, 045
Hawaii	1	5, 679	95, 857	1	6, 284	72, 092
Idaho	2	(1)	(1)	1	(1)	(1)
Illinois	10	115, 803	1, 084, 093	8	115, 523	1, 017, 001
Indiana	8	116, 171	830, 527	8	107, 209	734, 915
Iowa	2	(1)	(1)	2	(1)	(1)
Kentucky	3	6, 862	47, 620	2	(1)	(1)
Maine	5	116, 566	1, 230, 356	4	123, 023	1, 056, 443
Maryland	8	55, 405	439, 457	11	59, 508	440, 886
Massachusetts	10	189, 343	2, 325, 031	8	171, 944	2, 026, 019
Michigan	8	101, 172	931, 597	8	104, 917	962, 708
Minnesota	3	(1)	(1)	3	(1)	(1)
Missouri	15	267, 776	2, 189, 420	14	303, 014	2, 252, 420
Montana	3	11, 607	90, 512	2	(1)	(1)
Nevada	1	(1)	(1)	1	(1)	(1)
New Jersey	2	(1)	(1)	2	(1)	(1)
New Mexico	3	2, 042	20, 480	2	2, 002	19, 665
New York	14	98, 071	905, 116	13	93, 354	794, 301
North Carolina	1	(1)	(1)	1	(1)	(1)
Ohio	31	987, 726	9, 497, 324	28	1, 013, 676	8, 919, 596
Oklahoma	2	(1)	(1)	----------	----------	----------
Oregon	3	1, 105	21, 350	3	2, 090	34, 372
Pennsylvania	122	813, 571	6, 105, 241	130	834, 050	6, 119, 036
Porto Rico	14	7, 516	116, 618	15	9, 405	147, 040
Rhode Island	1	2, 937	43, 342	1	2, 589	36, 875
South Dakota	2	(1)	(1)	2	(1)	(1)
Tennessee	11	181, 385	1, 266, 326	9	183, 541	1, 238, 945
Texas	6	80, 796	733, 678	5	82, 325	751, 729
Utah	10	48, 882	397, 088	11	47, 662	385, 476
Vermont	10	61, 024	683, 440	8	52, 445	485, 235
Virginia	28	178, 426	1, 317, 581	32	174, 067	1, 208, 618
Washington	4	23, 959	382, 294	4	24, 529	265, 922
West Virginia	12	244, 950	1, 643, 109	12	279, 947	1, 788, 989
Wisconsin	22	197, 667	1, 733, 009	20	163, 965	1, 374, 749
Wyoming	1	30	600	----------	----------	----------
Undistributed	----------	66, 229	642, 121	----------	97, 642	857, 266
	417	4, 414, 932	38, 638, 413	411	4, 458, 412	36, 449, 635

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[1] Included under "Undistributed."

Lime sold by producers in the United States, 1927–28, by uses

Use	Quantity		Value	
	Percentage of total	Short tons	Total	Average
1927				
Agricultural	7.3	322,893	$2,237,871	$6.93
Building	48.7	2,148,840	20,962,759	9.76
Chemical:				
Glass works	1.8	78,994	665,026	8.42
Metallurgy	9.2	406,063	2,640,658	6.59
Paper mills	9.7	429,606	3,413,030	7.94
Refractory lime (dead-burned dolomite)	8.5	374,415	3,459,803	9.24
Sugar refineries	.4	16,086	235,555	14.64
Tanneries	1.4	63,666	501,442	7.88
Other uses [1]	13.0	574,369	4,522.269	7.87
Total chemical	44.0	1,943,199	15,437,783	7.94
	100.0	4,414,932	38,638,413	8.75
Hydrated lime (included in above totals)	36.2	1,596,906	14,581,695	9.13
1928				
Agricultural	7.5	333,910	2,287,558	6.85
Building	44.6	1,986,465	17,706,420	8.91
Chemical:				
Glass works	1.7	76,161	588,305	7.72
Metallurgy	11.3	504,248	3,055,081	6.06
Paper mills	9.6	429,334	3,260,733	7.59
Refractory lime (dead-burned dolomite)	10.1	448,761	4,283,036	9.54
Sugar refineries	.5	22,678	280,186	12.35
Tanneries	1.4	64,464	494,983	7.68
Other uses [1]	13.3	592,391	4,493,333	7.59
Total chemical	47.9	2,138,037	16,455,657	7.70
	100.0	4,458,412	36,449,635	8.18
Hydrated lime (included in above totals)	36.2	1,612,818	13,540,215	8.40

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[1] Details of distribution shown in following table.

It is necessary to classify much material as "unspecified," because many of the manufacturers do not report the uses of that part of their lime which they sell for chemical purposes. This lime is known to be applied to several of the uses enumerated, but the following figures are the best available.

Chemical lime sold by producers in the United States for "other uses," 1927–28

Use	1927		1928	
	Short tons	Value	Short tons	Value
Alcohol manufacture and dehydration	2, 199	$14, 554	2, 302	$14, 610
Alkali works (ammonia, soda, potash)	19, 610	146, 532	6, 675	54, 962
Bleaching powder	5, 723	43, 541	14, 970	116, 235
Bleach, liquid	10, 308	92, 863	18, 954	166, 319
Calcium acetate	9, 618	73, 887	1, 643	9, 460
Calcium carbide	27, 037	188, 613	32, 596	194, 334
Coke and gas manufacture (gas purification and plant by-products)	29, 988	215, 562	31, 011	214, 244
Glue	7, 864	65, 224	8, 467	65, 289
Insecticides (spraying materials)	22, 154	197, 581	19, 269	163, 005
Oil and fat manufacture	3, 899	38, 311	9, 119	81, 595
Oil refining	7, 101	69, 266	(1)	(1)
Paint (kalsomine, whitewash, varnish, etc.)	5, 050	42, 820	5, 017	47, 947
Rubber	4, 192	40, 455	3, 361	33, 863
Salt refining	1, 210	10, 139	2, 423	18, 167
Sand-lime and slag brick	43, 064	349, 430	47, 527	380, 650
Sanitation (sewage and garbage purification, etc.)	2, 416	15, 853	2, 857	18, 389
Silica brick	15, 638	120, 541	15, 735	120, 523
Soap	25, 487	161, 548	33, 759	181, 530
Textiles	1, 128	11, 697	1, 460	14, 101
Water purification	124, 212	1, 039, 351	145, 757	1, 158, 865
Wood distillation	11, 682	85, 046	3, 899	28, 496
Undistributed [2]	42, 973	348, 951	53, 198	436, 124
Unspecified	151, 816	1, 150, 504	132, 392	974, 625
	574, 369	4, 522, 269	592, 391	4, 493, 333

[1] Included under "Undistributed."

[2] Lime used in acid neutralization and drying, acetic acid, asphalt and fertilizer filler, bichromate refining, buffing compounds, calcium phosphate, cellulose, corn products, creameries and dairies, cyanide manufacture, disinfectants (chloride of lime, etc.), dyes, flour mills, food products, gelatin (edible), magnesia, oil refining, oxygen purification, retarder, and stock food.

Lime sold by producers in the United States in 1928, by States and uses

State	Building		Agricultural		Chemical												Total	
					Glass works		Paper mills		Sugar refineries		Tanneries		Metallurgy		Other chemical			
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Alabama	59, 194	$436, 359	(1)	(1)			22, 588	$144, 768	(1)	(1)			(1)	(1)	39, 938	$300, 734	192, 364	$1, 407, 232
Arizona	12, 759	156, 375	133	$2, 128	359	$5, 744					60	$708	19, 765	$129, 481	3, 168	48, 731	36, 244	343, 167
Arkansas	14, 426	141, 442	(1)	(1)			23, 470	172, 504							(1)	(1)	40, 438	339, 624
California	42, 256	424, 559	1, 851	11, 023			(1)	(1)			(1)	(1)	5, 425	57, 369	9, 704	108, 557	60, 751	617, 472
Colorado	3, 286	36, 385											3, 265	35, 255	1, 563	17, 135	8, 114	88, 775
Connecticut	44, 166	498, 198	2, 006	13, 918			1, 980	17, 820									48, 152	529, 936
Florida	4, 748	50, 086															4, 748	50, 086
Georgia	12, 548	80, 991	342	2, 054													12, 890	83, 045
Hawaii	347	5, 852	654	2, 844					5, 283	$63, 396							6, 284	72, 092
Idaho	(1)	(1)	(1)	(1)			(1)	(1)									(1)	(1)
Illinois	65, 701	613, 595					10, 884	84, 683			6, 645	60, 284	4, 734	34, 337	27, 559	224, 102	115, 523	1, 017, 001
Indiana	11, 542	90, 589	12, 257	35, 905	(1)	(1)	25, 300	165, 345			(1)	(1)	11, 760	72, 801	41, 664	333, 009	107, 209	734, 915
Iowa	(1)	(1)															(1)	(1)
Kentucky	(1)	(1)	(1)	(1)							(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Maine	66, 490	629, 748	13, 399	60, 131			(1)	(1)			(1)	(1)	(1)	(1)	(1)	(1)	123, 023	1, 056, 443
Maryland	(1)	(1)	45, 745	368, 608									(1)	(1)			59, 508	440, 886
Massachusetts	126, 232	1, 655, 582	3, 668	18, 166			15, 539	126, 248	405	7, 944	1, 659	17, 656	330	2, 970	24, 111	197, 453	171, 944	2, 026, 019
Michigan	7, 339	66, 932	(1)	(1)			84, 000	773, 517			(1)	(1)			11, 307	107, 704	104, 917	962, 708
Minnesota	(1)	(1)					(1)	(1)					(1)	(1)	(1)	(1)	(1)	(1)
Missouri	94, 025	805, 661	1, 780	11, 327	(1)	(1)	13, 399	82, 150			(1)	(1)	35, 084	202, 834	155, 243	1, 123, 746	303, 014	2, 252, 420
Montana	(1)	(1)											(1)	(1)	(1)	(1)	(1)	(1)
Nevada	(1)	(1)					(1)	(1)	(1)	(1)			(1)	(1)	(1)	(1)	(1)	(1)
New Jersey			(1)	(1)													(1)	(1)
New Mexico	862	8, 835													1, 140	10, 830	2, 002	19, 665
New York	26, 904	194, 777	3, 009	22, 202	92	866	14, 419	130, 185	105	857	5, 166	49, 982	14, 370	126, 740	29, 289	268, 692	93, 354	794, 301
North Carolina	(1)	(1)									(1)	(1)					(1)	(1)
Ohio	657, 865	5, 612, 487	29, 357	187, 419	69, 384	529, 870	35, 151	249, 800			(1)	(1)	(1)	(1)	199, 622	2, 175, 698	1, 013, 676	8, 919, 596
Oregon	1, 890	31, 572													200	2, 800	2, 090	34, 372
Pennsylvania	251, 056	1, 964, 044	154, 177	1, 133, 190	(1)	(1)	47, 686	329, 118	(1)	(1)	20, 912	157, 330	117, 961	665, 415	239, 770	1, 851, 210	834, 050	6, 119, 036
Porto Rico	246	2, 557	292	2, 740					8, 716	138, 917					151	2, 826	9, 405	147, 040
Rhode Island	1, 862	29, 922	669	6, 021											58	932	2, 589	36, 875
South Dakota	(1)	(1)	(1)	(1)									(1)	(1)	(1)	(1)	(1)	(1)
Tennessee	77, 701	675, 824	1, 441	7, 706			43, 246	223, 368	2, 940	26, 030	4, 173	21, 458	14, 908	68, 873	39, 132	215, 686	183, 541	1, 238, 945
Texas	50, 944	482, 195	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)			(1)	(1)	18, 464	172, 789	82, 325	751, 729
Utah	8, 801	131, 791	(1)	(1)					(1)	(1)			38, 022	241, 960	(1)	(1)	47, 662	385, 476
Vermont	27, 234	278, 965	3, 794	15, 004			8, 501	71, 028			2, 868	29, 229	4, 352	37, 886	5, 696	53, 123	52, 445	485, 235
Virginia	69, 825	536, 468	38, 493	244, 584			15, 261	99, 387	720	4, 860	8, 693	54, 084	977	5, 265	40, 098	263, 970	174, 067	1, 208, 618
Washington	15, 217	167, 012	(1)	(1)			3, 513	37, 569	(1)	(1)			(1)	(1)	(1)	(1)	24, 529	265, 922
West Virginia	28, 450	204, 565	17, 201	115, 281	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	134, 043	1, 048, 569	279, 947	1, 788, 989
Wisconsin	153, 389	1, 228, 128	(1)	(1)			7, 691	66, 081			(1)	(1)			(1)	(1)	163, 965	1, 374, 749
Undistributed	49, 160	465, 524	3, 642	27, 307	6, 326	51, 825	56, 706	487, 162	4, 509	38, 182	14, 288	104, 252	233, 295	1, 373, 895	19, 232	248, 073	97, 642	857, 266
	1, 986, 465	17, 706, 420	333, 910	2, 287, 558	76, 161	588, 305	429, 334	3, 260, 733	22, 678	280, 186	64, 464	494, 983	504, 248	3, 055, 081	1, 041, 152	8, 776, 369	4, 458, 412	36, 449, 635

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(1) Included under "Undistributed."

BUILDING LIME

Sales of lime for construction amounted to 1,986,465 short tons, valued at $17,706,420, in 1928, a decrease of 7.6 per cent in quantity and 15.5 per cent in value from 1927. Lime of this class apparently was more affected by trade conditions, competition, overproduction, and price cutting than chemical or agricultural lime, as sales of both of these classes of lime increased in quantity and to a smaller extent in value. A few States showed an increased output of building lime, but such increases were of no special significance. Ohio, Pennsylvania, Wisconsin, and Massachusetts are the largest producers of lime for building, but sales for this purpose from these States in 1928 decreased 5, 8, 18, and 16 per cent, respectively, from those in 1927, and in Ohio and Pennsylvania followed decreases in 1927 of 8 and 6 per cent, respectively, from 1926. Ohio produced 33 per cent of the building lime sold by producers in the United States in 1928; 98 per cent of this output was hydrated lime, the greater part of which was sold as high-grade finishing lime. The sales from Ohio, classified according to kinds of lime, are given in the following table.

Lime sold by Ohio producers for construction, 1926–1928

	1926		1927		1928	
	Short tons	Value	Short tons	Value	Short tons	Value
Quicklime	26,735	$209,460	21,750	$160,168	15,721	$99,363
Hydrated lime	726,803	7,220,340	671,294	6,607,660	642,144	5,513,124
	753,538	7,429,800	693,044	6,767,828	657,865	5,612,487

Of the total hydrated lime sold by producers in the United States in 1928, Ohio produced 674,644 tons (4 per cent less than in 1927) or 42 per cent. Of this total 642,144 tons (95 per cent) was sold for construction and was widely distributed throughout continental United States. Figures of distribution, as reported to the Bureau of Mines, presented for blocks of contiguous States roughly comprising various freight-rate zones are given in the next table. Possibly some of the lime reported as supplied to the various districts is reshipped by dealers.

Shipments of hydrated lime from plants in the United States and in Ohio, 1927–28, by destinations

Destination	From all plants		From Ohio plants		
	Short tons	Distribution (per cent)	Short tons	Distribution (per cent)	Group total (per cent)
1927					
Illinois, Indiana, Michigan, Ohio	443,670	27.8	338,469	48.2	76.3
Delaware, District of Columbia, Maryland, New Jersey, New York, Pennsylvania, West Virginia	649,564	40.7	252,455	35.9	38.9
Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont	73,046	4.6	22,046	3.1	30.2
Florida, Georgia, North Carolina, South Carolina, Virginia	140,001	8.8	35,642	5.1	25.5
Alabama, Kentucky, Louisiana, Mississippi, Tennessee	75,911	4.7	20,244	2.9	26.7
Arkansas, Iowa, Kansas, Minnesota, Missouri, Nebraska, Oklahoma, Texas, Wisconsin	157,794	9.9	28,016	4.0	17.8
Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, North Dakota, Oregon, South Dakota, Utah, Washington, Wyoming	46,837	2.9	2,031	.3	4.3
Undistributed and exports	10,083	.6	3,343	.5	33.2
	1,596,906	100.0	702,246	100.0	44.0
1928					
Illinois, Indiana, Michigan, Ohio	417,086	25.9	306,733	45.5	73.5
Delaware, District of Columbia, Maryland, New Jersey, New York, Pennsylvania, West Virginia	647,443	40.1	249,683	37.0	38.6
Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont	77,749	4.8	25,582	3.8	32.9
Florida, Georgia, North Carolina, South Carolina, Virginia	145,884	9.1	35,083	5.2	24.0
Alabama, Kentucky, Louisiana, Mississippi, Tennessee	92,607	5.7	19,983	3.0	21.6
Arkansas, Iowa, Kansas, Minnesota, Missouri, Nebraska, Oklahoma, Texas, Wisconsin	165,016	10.2	30,708	4.5	18.6
Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, North Dakota, Oregon, South Dakota, Utah, Washington, Wyoming	54,085	3.4	2,961	.4	5.5
Undistributed and exports	12,948	.8	3,911	.6	30.2
	1,612,818	100.0	674,644	100.0	41.8

CHEMICAL LIME

Sales of lime for chemical use amounted to 2,138,037 tons, valued at $16,455,657, in 1928, an increase of 10 per cent in quantity and 6.6 per cent in value from 1927. The demand for chemical lime in 1928 was better than that for any other class. Pennsylvania, Ohio, West Virginia, and Missouri are the largest producers of chemical lime. The quantity and value of lime used in the various chemical industries, so far as reported to the Bureau of Mines, are given in the tables on pages 177 to 179.

AGRICULTURAL LIME AND OTHER LIMING MATERIALS

An increase of 3 per cent in quantity and 2 per cent in value over 1927 marked the output of lime for agriculture in 1928, and sales amounted to 333,910 short tons, valued at $2,287,558, of which nearly one-third (110,533 tons) was quicklime and more that two-thirds (223,377 tons) hydrated lime. Pennsylvania, Maryland, Virginia, and Ohio are the largest producers. The production of agricultural lime, as well as the output of pulverized limestone for agricultural purposes, has in general increased since 1924. The output of agricultural limestone in 1928—2,186,870 short tons, valued at $3,153,848—was, however, a decrease of nearly 1 per cent in quantity and of 6 per cent in value from 1927. The quantity of lime reported as burned from oyster shells and used for liming land decreased, but sales of calcareous marl (61,034 short tons, valued at $200,704), of which all but a negligible quantity sold as a filler was used for agriculture, increased 15 per cent in quantity. The table following gives available data on the quantity and value of different kinds of liming materials sold by producers in 1927 and 1928. The method by which the effective lime content of the different forms of land lime is calculated was explained in Mineral Resources for 1921.

Agricultural lime and other liming materials sold by producers in the United States, 1927–28, by kinds

Kind	Short tons		Value	
	Gross	Effective lime content	Total	Average
1927				
Lime from limestone:				
Quicklime	107, 866	90, 530	$615, 789	$5. 71
Hydrated	215, 027	150, 500	1, 622, 082	7. 54
Lime from oyster shells	22, 081	18, 400	175, 234	7. 94
Limestone (pulverized)	2, 206, 470	949, 000	3, 360, 704	1. 52
Calcareous marl	52, 962	22, 800	180, 166	3. 40
1928				
Lime from limestone:				
Quicklime	110, 533	93, 000	639, 615	5. 79
Hydrated	223, 377	156, 000	1, 647, 943	7. 38
Lime from oyster shells [1]	15, 371	13, 000	126, 844	8. 25
Limestone (pulverized)	2, 186, 870	940, 000	3, 153, 848	1. 44
Calcareous marl	61, 034	26, 000	200, 704	3. 29

[1] Department of Agriculture, Bureau of Fisheries, Statistical Bulletin 821, p. 7.

The figures in the preceding table do not include calcareous marl used for the manufacture of cement; they represent the output of fresh-water marl, chiefly for agriculture. The chief producing States are Virginia, with 29,818 short tons, valued at $95,108, in 1928, and West Virginia. The other States producing in 1928 were California, Illinois, Maine, Minnesota, North Carolina, Ohio, South Carolina, and Utah.

HYDRATED LIME

Statistics of the output of hydrated lime include only the product made in hydrating machines; they exclude hand-slaked lime. Hydrated lime has shown a general increase in production since the figures of output (120,357 short tons) were first reported for 1906. There have been since 1906 but six years (1908, 1911, 1917, 1918, 1921, and 1927) in which the production has been below that of the preceding year. The output in 1928—1,612,818 short tons, valued at $13,540,215—represents an increase of 1 per cent in quantity over 1927 but a decrease of 7 per cent in value. Seven more firms reported the hydrated product in 1928 than in 1927. The greater part of the hydrated lime is sold for construction; 69 per cent of the total was sold in 1928 for construction, 17 per cent for the manufacture of chemicals, and 14 per cent for agriculture. Sales of hydrated lime for agricultural and chemical use increased in 1928, but those for construction decreased somewhat.

Hydrated lime sold by producers in the United States, 1919–1928

Year	Number of plants in operation	Short tons	Value	
			Total	Average
1919	93	777, 408	$7, 061, 146	$9. 08
1920	98	853, 116	9, 287, 562	10. 89
1921	105	792, 970	7, 421, 637	9. 36
1922	114	1, 106, 063	9, 868, 980	8. 92
1923	121	1, 225, 928	12, 229, 598	9. 98
1924	120	1, 316, 664	13, 199, 846	10. 03
1925	134	1, 560, 848	15, 287, 461	9. 79
1926	147	1, 606, 811	15, 182, 460	9. 45
1927	157	1, 596, 906	14, 581, 695	9. 13
1928	164	1, 612, 818	13, 540, 215	8. 40

Hydrated lime sold by producers in the United States, 1927–28, by States

State	1927		1928	
	Short tons	Value	Short tons	Value
Alabama	31, 055	$232, 466	34, 376	$269, 727
California	11, 965	148, 326	14, 245	165, 481
Florida	3, 809	38, 458	3, 680	34, 229
Georgia	13, 173	96, 683	12, 593	81, 256
Hawaii	4, 865	81, 073	6, 187	70, 928
Illinois	29, 909	269, 241	31, 214	262, 869
Indiana	44, 183	375, 238	41, 664	333, 355
Maryland	28, 747	240, 838	29, 091	247, 540
Massachusetts	19, 955	165, 249	18, 920	146, 525
Michigan	17, 303	202, 812	18, 135	212, 748
Missouri	84, 402	752, 280	100, 217	853, 577
New York	37, 842	311, 733	35, 084	260, 690
Ohio	702, 246	6, 832, 732	674, 644	5, 723, 712
Pennsylvania	264, 491	2, 147, 828	273, 973	2, 185, 386
Rhode Island	652	5, 868	669	6, 021
Tennessee	57, 609	480, 129	69, 721	580, 348
Texas	33, 749	326, 903	35, 133	344, 444
Vermont	10, 571	128, 443	11, 291	88, 449
Virginia	64, 132	509, 822	69, 988	488, 602
West Virginia	44, 646	295, 772	40, 464	273, 944
Wisconsin	13, 698	161, 617	11, 560	119, 416
Undistributed [1]	77, 904	778, 184	79, 969	790, 968
	1, 596, 906	14, 581, 695	1, 612, 818	13, 540, 215

[1] 1927: Arizona, Arkansas, Colorado, Connecticut, Kentucky, Maine, Minnesota, Montana, Nevada, New Jersey, North Carolina, Utah, and Washington. 1928: Arizona, Arkansas, Colorado, Connecticut, Kentucky, Maine, Minnesota, Montana, Nevada, New Jersey, North Carolina, Oregon, Utah, and Washington.

Hydrated lime sold by producers in the United States, 1927–28, by uses

Use	1927		1928	
	Short tons	Value	Short tons	Value
Agricultural	215, 027	$1, 622, 082	223, 377	$1, 647, 943
Building	1, 125, 802	10, 566, 601	1, 108, 112	9, 406, 621
Chemical:				
Glass works	3, 069	30, 426	4, 589	42, 707
Metallurgy	15, 237	157, 877	17, 336	165, 626
Paper mills	38, 017	386, 902	31, 752	317, 054
Sugar refineries	7, 870	111, 117	10, 605	113, 413
Tanneries	23, 196	195, 323	23, 152	186, 551
Other uses	168, 688	1, 511, 367	193, 895	1, 660, 300
Total chemical	256, 077	2, 393, 012	281, 329	2, 485, 651
	1, 596, 906	14, 581, 695	1, 612, 818	13, 540, 215

EXPORTS AND IMPORTS[1]

Lime exported from the United States, 1919–1928

Year	Short tons	Value	Year	Short tons	Value
1919	6,372	$108,370	1924	14,905	$212,340
1920	5,921	128,296	1925	14,800	218,696
1921	5,192	109,769	1926	12,960	191,768
1922	8,289	116,649	1927	15,478	210,977
1923	11,789	170,289	1928	18,188	245,004

Lime exported from the United States, 1927–28, by countries

Country	1927		1928	
	Short tons	Value	Short tons	Value
North America:				
Canada	8,260	$98,124	8,983	$104,404
Central America—				
British Honduras	-----	-----	2	24
Guatemala	3	96	16	322
Honduras	218	3,400	450	6,144
Nicaragua	76	1,910	232	5,505
Panama	93	2,291	213	4,699
Salvador	91	2,235	36	727
Mexico	3,082	29,858	2,730	26,210
Newfoundland and Labrador	-----	-----	1	23
West Indies—				
British—				
Bermuda	(a)	10	-----	-----
Jamaica	147	2,840	148	2,737
Other British	3	74	101	2,210
Cuba	283	5,424	353	5,707
Dominican Republic	927	12,782	1,138	10,449
Haiti	1	69	-----	-----
Netherland	-----	-----	76	2,097
Virgin Islands of the United States	86	2,531	66	2,113
South America:				
Argentina	(a)	26	1	76
Bolivia	-----	-----	30	600
Brazil	20	738	7	252
Chile	221	2,391	197	3,118
Colombia	158	3,770	289	5,969
Ecuador	1	22	2	45
Guiana—				
British	21	384	-----	-----
Surinam (Netherland)	2	37	5	100
Peru	519	9,146	666	14,361
Uruguay	-----	-----	(a)	20
Venezuela	117	2,368	15	571
Europe:				
Sweden	28	1,060	34	1,575
United Kingdom	91	5,104	2	100
Asia:				
China	-----	-----	1	25
Japan, including Chosen	84	3,812	632	6,126
Philippine Islands	913	19,149	1,728	33,300
Africa:				
British—				
South, Union of	(a)	38	19	5,000
West	3	91	-----	-----
Liberia	2	50	6	168
Oceania:				
Australia	8	190	6	175
French Oceania	15	784	3	52
New Zealand	5	160	-----	-----
Other	(a)	13	-----	-----
	15,478	210,977	18,188	245,004

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[a] Less than 1 ton.

[1] Figures on imports and exports compiled by J. A. Dorsey, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.

Lime imported for consumption in the United States, 1919–1928 [1]

Year	Short tons	Value	Year	Short tons	Value
1919	8,679	$128,519	1924	20,480	$377,994
1920	22,688	392,137	1925	15,323	285,599
1921	10,811	234,798	1926	18,702	346,969
1922	14,112	290,845	1927	19,567	356,836
1923	25,407	428,903	1928	18,321	344,296

[1] Most of the lime imported into the United States comes from Canada.

SHIPMENTS

Shipments of lime, as reported to the Bureau of Mines by the producers, have been combined to show the movement of this product according to its origin in and destination in State groups which approximately comprise various freight-rate zones. These figures do not cover an inconsiderable quantity of lime (less than 1 per cent of the total) comprising the production in Hawaii and Porto Rico, the shipments abroad, and the product for which distribution is not recorded.

The results of the compilation for 1928 are given in the following table.

Lime shipped in continental United States in 1928, by origin and destination of shipments, in short tons

Destination	Illinois, Indiana, Michigan, Ohio			Maryland, New Jersey, New York, Pennsylvania, West Virginia			Connecticut, Maine, Massachusetts, Rhode Island, Vermont			Florida, Georgia, North Carolina, Virginia		
	Hydrated lime	Quicklime	Total	Hydrated lime	Quicklime	Total	Hydrated lime	Quicklime	Total	Hydrated lime	Quicklime	Total
Illinois, Indiana, Michigan, Ohio	371,545	385,226	756,771	8,023	81,742	89,765	4	3	7	428	1,322	1,750
Delaware, District of Columbia, Maryland, New Jersey, New York, Pennsylvania, West Virginia	249,920	72,017	321,937	356,967	758,502	1,115,469	17,705	166,843	184,548	21,529	52,381	73,910
Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont	25,582		25,582	8,237	33,320	41,557	43,780	168,943	212,723		594	594
Florida, Georgia, North Carolina, South Carolina, Virginia	35,083	4,079	39,162	6,266	5,407	11,673				65,869	56,005	121,874
Alabama, Kentucky, Louisiana, Mississippi, Tennessee	22,041	29,197	51,238		540	540				220	107	327
Arkansas, Iowa, Kansas, Minnesota, Missouri, Nebraska, Oklahoma, Texas, Wisconsin	52,586	81,975	134,561	1	7,868	7,869	5		5			
Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, North Dakota, Oregon, South Dakota, Utah, Washington, Wyoming	4,299	160	4,459									

Destination	Alabama, Kentucky, Tennessee			Arkansas, Iowa, Minnesota, Missouri, Texas, Wisconsin			Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, South Dakota, Utah, Washington			United States		
	Hydrated lime	Quicklime	Total	Hydrated lime	Quicklime	Total	Hydrated lime	Quicklime	Total	Hydrated lime	Quicklime	Total
Illinois, Indiana, Michigan, Ohio	1,030	23,002	24,032	36,056	172,112	208,168				417,086	663,407	1,080,493
Delaware, District of Columbia, Maryland, New Jersey, New York, Pennsylvania, West Virginia				1,322	1,333	2,655				647,443	1,051,076	1,698,519
Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont				150	33	183				77,749	202,890	280,639
Florida, Georgia, North Carolina, South Carolina, Virginia	38,539	57,380	95,919	127	1,307	1,434				145,884	124,178	270,062
Alabama, Kentucky, Louisiana, Mississippi, Tennessee	65,681	204,244	269,925	4,665	30,406	35,071				92,607	264,494	357,101
Arkansas, Iowa, Kansas, Minnesota, Missouri, Nebraska, Oklahoma, Texas, Wisconsin	300	200	500	111,923	230,923	342,846	201	630	831	165,016	321,596	486,612
Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, North Dakota, Oregon, South Dakota, Utah, Washington, Wyoming				8,022	20,197	28,219	41,764	179,649	221,413	54,085	200,006	254,091

CLAY

By Jefferson Middleton

GENERAL CONDITIONS

Clay available for the manufacture of clay products, the largest use, is widely distributed throughout the United States, and there are clay-working plants in every State. The tables of production that follow represent chiefly the clay that was mined and sold as clay, or mined under royalty or shipped into another State for fabrication, and do not include the clay that was burned into clay products by the producers themselves, unless it was mined under royalty or in a different State from that in which it was used. The quantity of clay thus sold is small compared with the total output and mainly includes clay used for making high-grade pottery and tile, paper, and refractory products. The values given for domestic production are f. o. b. mines or works; for imports, at the principal markets of the countries from which the clay was exported; for exports, at the port of shipment.

The domestic clay-mining industry had an active year in 1928. The total quantity and total value of clay sold by producers increased slightly compared with 1927. Each kind of clay, as classified in this report, except slip clay and stoneware clay increased in quantity compared with 1927, and each kind except slip clay and fire clay increased in value. The total sales of clay in 1928 have been exceeded by those in 1925 only; they were 35 per cent greater than the sales in 1918. The total value of the clay sold in 1928 was the highest ever recorded; it amounted to $14,200,739, or nearly 1 per cent more than the value in 1926, the year of greatest value prior to 1928. Sales of clay in 1928 were 5 per cent greater in quantity and 4 per cent greater in value than sales in 1927. Kaolin and ball clay were the only kinds to reach maximum quantity and value in 1928.

The increasing sales of domestic clays for use in the higher grades of ceramic ware and paper and for other products, the demand for which has been largely supplied by foreign material, together with the decrease in imports of kaolin, indicate the growing use of domestic clays in these industries and lead to the hope that domestic manufacturers of these commodities may become independent of foreign supplies. In 1928 domestic mines supplied 62 per cent of the new supply of kaolin in the United States.

A use for kaolin has recently been developed in the glass industry, the kaolin being used as a substitute for feldspar as a source of alumina, and it is said that several carloads of southern kaolin are being used each month for this purpose. This use provides another outlet—although perhaps a comparatively small one—for kaolin.

The interest in bentonite and the meager information concerning it led the Bureau of Mines to study the subject. As a result, Technical Paper 438, Bentonite, Its Properties, Mining, Preparation, and Utilization, by C. W. Davis and H. C. Vacher, has been published. This report treats the subject in a comprehensive manner. It may be obtained from the Superintendent of Documents, Government Printing Office, Washington, D. C., for 10 cents.

The estimated sales of bentonite amounted to 66,577 tons, valued at $685,923, in 1928, compared with 34,089 tons, valued at $367,457, in 1927. The States from which bentonite was reported sold in 1928, in order of importance, were: Wyoming, Nevada, Arizona, Utah, California, and South Dakota.

Another recent publication of the Bureau of Mines on clay is Information Circular 6155, July, 1929, Clay, by Paul M. Tyler. This publication contains a general survey of the clay-mining and clay-working industries and includes a general description of clay, its occurrence, use, methods of testing, classification, mining and preparation methods, the methods used in the preparation of products, imports and exports, tariff duties, prices, royalties, economic considerations, etc., and contains much information of value to those who consider entering as well as those engaged in these industries.

Sales of domestic kaolin, the chief clay used in the manufacture of high-grade ceramic wares, paper, etc., increased 9 per cent in quantity in 1928 over 1927, whereas the imports of kaolin or china clay decreased 9 per cent. The Southern States are the chief source of supply of kaolin; they produced 84 per cent of the total in 1928, and Georgia, the largest producer, reported 47 per cent of the total. The increase of 21 per cent in the output of Georgia and the increase of 36 per cent in the output of South Carolina are noteworthy.

Ball clay, which is principally used with kaolin in the bodies of high-grade ceramic wares, increased only 1 per cent in quantity but 8 per cent in value compared with 1927.

Slip clay, a low-temperature fusing material that formerly was used chiefly as a glaze on stoneware, now finds its main use as a binder in the manufacture of artificial abrasives. In 1928 sales of slip clay decreased 7 per cent in quantity and nearly 5 per cent in value compared with 1927. The sources of supply of slip clay in 1928 were Michigan and New York.

Stoneware clay, the principal use of which is indicated by its name, decreased 3 per cent in quantity but increased 2 per cent in value compared with 1927. The term "stoneware clay" is used rather loosely, and much, if not all, of the fire and miscellaneous clays reported as having been sold for the manufacture of stoneware might properly be classed as stoneware clay.

Fire clay, which constituted 69 per cent of the total quantity of clay sold by producers in 1928, increased 3 per cent in quantity but decreased 3 per cent in value compared with 1927. Sales were 21 per cent greater in quantity and 32 per cent greater in value in 1928 than in 1918. The sales of fire clay in 1928 were the second largest ever recorded and have been exceeded by those in 1926 only. As its name indicates, the chief use of fire clay is in the refractory industries. Considerable quantities are also used in the manufacture of sanitary ware, stoneware, high-grade tile, architectural terra cotta, saggers, plaster, and other commodities.

Miscellaneous clays embrace those used in many industries; the larger part of the output is used in the manufacture of heavy-clay products, such as building and drainage materials. Clay included under this head is also used for cosmetics, filtering oil (after chemical treatment), flower pots, foundries, modeling, pencil leads, taxidermy, water softening, and other purposes.

PRODUCTION

Clay sold by producers in the United States, 1919–1928, by kinds

Year	Kaolin or china clay and paper clay		Ball clay		Slip clay		Fire clay	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1919	152, 828	$1, 475, 681	65, 026	$520, 849	5, 149	$17, 556	1, 755, 331	$4, 628, 605
1920	268, 203	2, 865, 407	69, 477	584, 611	9, 006	41, 519	2, 261, 915	7, 088, 049
1921	162, 726	1, 579, 163	54, 014	354, 565	4, 608	14, 841	1, 195, 861	3, 560, 373
1922	275, 675	2, 346, 095	76, 792	440, 877	4, 050	19, 405	1, 679, 220	4, 633, 486
1923	336, 803	2, 926, 255	97, 068	620, 978	8, 520	43, 609	2, 298, 163	6, 565, 899
1924	326, 611	2, 923, 965	83, 034	581, 966	5. 910	31, 023	2, 443, 710	6, 737, 063
1925	367, 319	3, 220, 719	109, 607	699, 427	7, 349	37, 397	2, 566, 934	7, 312, 349
1926	432, 215	3. 771, 568	112, 195	867, 500	8, 644	45, 959	2, 819, 346	8, 119, 323
1927	454, 245	3, 809, 834	119, 763	913, 976	6, 137	32, 264	2, 699, 761	7, 719, 725
1928	496, 142	4, 088, 003	120, 878	984, 075	5, 699	30, 796	2, 785, 158	7, 480, 609

Year	Stoneware clay		Miscellaneous clay		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1919	60, 236	$80, 367	236, 530	$367, 573	2, 275, 100	$7, 090, 631
1920	106, 350	229, 221	322, 100	467, 856	3, 037, 051	11, 276, 663
1921	86, 574	184, 540	242, 963	361, 818	1, 746, 746	6, 055, 300
1922	86, 866	164, 870	525, 097	725, 781	2, 647, 700	8, 330, 514
1923	81, 389	194, 358	612, 717	837, 814	3, 434, 660	11, 188, 913
1924	59, 194	117, 142	772, 660	1, 116, 377	3, 691, 119	11, 507, 536
1925	77, 438	162, 161	901, 773	1, 304, 579	4, 030, 420	12, 736, 632
1926	84, 002	185, 288	510, 796	1, 115, 951	3, 967, 198	14, 105, 589
1927	98, 355	203, 648	470, 915	1, 017, 712	3, 849, 176	13, 697, 159
1928	95, 626	207, 275	522, 829	1, 409, 981	4, 026, 332	14, 200, 739

Clay sold by producers in the United States in 1927, by States and kinds

State	Number of operators reporting sales	Kaolin or china clay and paper clay		Ball clay		Fire clay		Stoneware clay		Miscellaneous clay [1]		Total	
		Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Alabama	13					120,831	$169,345			6,566	$7,073	127,397	$176,418
Arizona	1									(2)	(2)	(2)	(2)
Arkansas	2					335	1,966					335	1,966
California	34	939	$9,416	5,012	$22,131	194,479	456,489	4,107	$11,510	85,772	278,874	290,309	778,420
Colorado	19	50	131			186,068	284,389	930	2,325	31,207	33,149	218,255	319,994
Connecticut	3					(2)	(2)			(2)	(2)	621	6,225
Delaware	3	4,893	77,004			1,062	3,186			606	2,466	6,561	82,656
District of Columbia	1									(2)	(2)	(2)	(2)
Florida	4	47,319	646,415									47,319	646,415
Georgia	17	193,151	1,492,857			(2)	(2)			(2)	(2)	222,938	1,537,378
Idaho	2					477	5,748					477	5,748
Illinois	21			854	15,109	170,571	319,913	20,187	29,390	6,694	16,816	198,306	381,228
Indiana	12	1,500	7,500			122,354	155,123			39,739	43,738	163,593	206,361
Iowa	4					2,458	16,416			5	100	2,463	16,516
Kentucky	18			50,694	421,930	(2)	(2)			(2)	(2)	119,829	662,149
Maine	3					(2)	(2)			(2)	(2)	266	3,392
Maryland	13	(2)	(2)	(2)	(2)	12,145	51,266			10,197	14,220	38,551	102,690
Massachusetts	9					849	10,277			777	12,963	1,626	23,240
Michigan	4									3,539	6,620	3,539	6,620
Minnesota	5							16,806	38,028	481	2,612	17,287	40,640
Mississippi	3					1,805	18,488	(2)	(2)	(2)	(2)	2,805	20,308
Missouri	36	(2)	(2)	(2)	(2)	409,520	1,669,551	4,528	7,924	917	1,817	416,490	1,693,792
Montana	4					5,635	20,142			7,572	4,089	13,207	24,231
Nebraska	5					200	625			3,931	4,134	4,131	4,759
Nevada	4	1,066	8,991							4,844	27,467	5,910	36,458
New Jersey	43			5,901	33,083	251,205	1,134,143	12,406	55,298	42,898	48,048	312,410	1,270,572
New Mexico	6					8,196	17,414					8,196	17,414
New York	7					1,733	20,741			5,678	30,371	7,411	51,112
North Carolina	5	20,334	327,638					50	50			20,384	327,688
North Dakota	1	4	52			14	263					18	315
Ohio	62					283,936	730,082	35,022	50,271	6,177	19,579	325,135	799,932
Oregon	3					310	574	(2)	(2)	(2)	(2)	2,570	2,834
Pennsylvania	94	75,939	342,607			700,869	1,895,668	1,323	3,744	119,667	161,409	897,798	2,403,428
South Carolina	10	78,401	666,269			(2)	(2)			(2)	(2)	81,010	743,742
South Dakota	2									1,056	4,194	1,056	4,194
Tennessee	12			45,593	380,019	61,243	230,668			42,793	51,126	149,629	661,813
Texas	10					2,449	15,055			744	4,008	3,193	19,063
Utah	7					9,714	25,785			7,599	82,595	17,313	108,380
Vermont	1	(2)	(2)									(2)	(2)
Virginia	3	(2)	(2)			663	2,570			(2)	(2)	25,497	211,869
Washington	9					720	8,423	726	2,178	30,017	29,827	31,463	40,428

West Virginia	5					48,332	85,304					48,332	85,304
Wisconsin	2									(2)	(2)	(2)	(2)
Wyoming	4					2	17			7,498	121,146	7,500	121,163
Undistributed		30,649	230,954	11,709	41,704	101,586	370,094	2,270	2,930	10,078	41,535	8,046	50,304
	526	454,245	3,809,834	119,763	913,976	[3] 2,699,761	[3] 7,719,725	98,355	203,648	[4] 477,052	[4] 1,049,976	3,849,176	13,697,159
Average value per ton			8.39		7.63		2.86		2.07				3.56

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[1] Includes ardmorite, bentonite, montmorillonite, shale, etc. Slip clay is also included in this column as a matter of statistical convenience.

[2] Included under "Undistributed."

[3] These totals include 40,085 tons of diaspore and burley clay from Missouri, valued at $229,093.

[4] These totals include 6,137 tons of slip clay, valued at $32,264, or $5.26 a ton, from Michigan (460 tons, valued at $1,908) and New York (5,677 tons, valued at $30,356).

Clay sold by producers in the United States in 1928, by States and kinds

State	Number of operators reporting sales	Kaolin or china clay and paper clay		Ball clay		Fire clay		Stoneware clay		Miscellaneous clay [1]		Total	
		Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Alabama	13					124, 592	$173, 206			7, 216	$5, 728	131, 808	$178, 934
Arizona	1									11, 473	45, 892	11, 473	45, 892
Arkansas	1					266	1, 064					266	1, 064
California	40	800	$10, 873	3, 667	$17, 252	205, 990	511, 916	1, 312	$5, 493	127, 728	418, 309	339, 497	963, 843
Colorado	18					70, 110	167, 500			84, 965	89, 048	155, 075	256, 548
Connecticut	2					329	4, 277			450	1, 350	779	5, 627
Delaware	2	5, 638	84, 736									5, 638	84, 736
Florida	4	46, 496	630, 471									46, 496	630, 471
Georgia	17	234, 028	1, 668, 125			15, 486	19, 439	90	90			249, 604	1, 687, 654
Idaho	2					494	6, 095					494	6, 095
Illinois	23			(2)	(2)	224, 322	404, 071	21, 220	35, 970	(2)	(2)	248, 618	466, 290
Indiana	13					132, 087	163, 430			38, 425	38, 785	170, 512	202, 215
Iowa	5					2, 833	21, 900			1, 221	1, 600	4, 054	23, 500
Kentucky	18			53, 204	460, 778	(2)	(2)			(2)	(2)	149, 317	757, 505
Maine	3					89	1, 780			84	104	173	1, 884
Maryland	11			(2)	(2)	7, 119	34, 184			(2)	(2)	60, 762	91, 547
Massachusetts	7					(2)	(2)			(2)	(2)	2, 158	11, 848
Michigan	5									3, 805	6, 949	3, 805	6, 949
Minnesota	5							17, 727	39, 886	839	3, 687	18, 566	43, 573
Mississippi	1							1, 320	2, 310			1, 320	2, 310
Missouri	32			1, 440	10, 080	420, 586	1, 425, 564	4, 000	7, 000			426, 026	1, 442, 644
Montana	3					11, 954	63, 032			12, 589	10, 071	24, 543	73, 103
Nebraska	5					132	538			19, 020	19, 193	19, 152	19, 731
Nevada	4	918	7, 855							12, 591	53, 668	13, 509	61, 523
New Jersey	38			11, 377	74, 073	212, 514	963, 609	13, 082	61, 390	23, 769	34, 776	260, 742	1, 133, 848
New Mexico	5					5, 338	6, 597					5, 338	6, 597
New York	6					(2)	(2)			(2)	(2)	7, 214	37, 201
North Carolina	5	19, 788	298, 841			(2)	(2)	(2)	(2)			19, 898	298, 951
North Dakota	2	12	192			25	100			7	140	44	432
Ohio	64					269, 689	692, 706	27, 536	40, 895	6, 460	18, 706	303, 685	752, 307
Oregon	2					(2)	(2)	(2)	(2)			(2)	(2)
Pennsylvania	90	71, 552	383, 675			865, 024	2, 100, 469	(2)	(2)	(2)	(2)	971, 148	2, 532, 105
South Carolina	11	106, 828	925, 801			2, 258	73, 902			100	400	109, 186	1, 000, 103
South Dakota	1									1, 066	10, 660	1, 066	10, 660
Tennessee	9			39, 851	370, 181	(2)	(2)	(2)	(2)	30, 776	39, 574	123, 587	613, 554
Texas	9					2, 651	16, 803			507	2, 028	3, 158	18, 831
Utah	6					(2)	(2)			(2)	(2)	24, 897	156, 951
Vermont	1	(2)	(2)									(2)	(2)
Virginia	3	(2)	(2)			746	2, 717			(2)	(2)	9, 970	71, 147
Washington	7					5, 906	18, 925	(2)	(2)	(2)	(2)	35, 041	39, 632
West Virginia	6					41, 836	66, 621					41, 836	66, 621

Wisconsin	2									508	983	508	983
Wyoming	7					3	24			22, 918	383, 970	22, 921	383, 994
Undistributed		10, 082	77, 434	11, 339	51, 711	162, 779	540, 140	9, 339	14, 241	122, 011	255, 156	2, 448	11, 336
	509	496, 142	4, 088, 003	120, 878	984, 075	[3] 2, 785, 158	[3] 7, 480, 609	95, 626	207, 275	[4] 528, 528	[4] 1, 440, 777	4, 026, 332	14, 200, 739
Average value per ton			8. 24		8. 14		2. 69		2. 17				3. 53

[1] Includes ardmorite, bentonite, shale, etc. Slip clay is also included in this column as a matter of statistical convenience.

[2] Included under "Undistributed."

[3] These totals include 37,439 tons of diaspore and burley clay from Missouri, valued at $207,155.

[4] These totals include 5,699 tons of slip clay from Michigan and New York, valued at $30,796, or $5.40 a ton.

In 1928 operators in 43 States reported the sale of clay as such. The leading 10 States in order of quantity sold in 1928 were: Pennsylvania (24.1 per cent of the total of the United States), Missouri (10.6 per cent), California (8.4 per cent), Ohio (7.5 per cent), New Jersey (6.5 per cent), Georgia (6.2 per cent), Illinois (6.2 per cent), Indiana (4.2 per cent), Colorado (3.9 per cent), and Kentucky (3.7 per cent). Pennsylvania, Missouri, and Georgia maintained the ranks they held in 1927—namely, first, second, and sixth. California rose from fifth to third, Illinois from eight to seventh, and Indiana from ninth to eight; Ohio fell from third to fourth, New Jersey from fourth to fifth, and Colorado from seventh to ninth. Tennessee, which was tenth in 1927, was twelfth in 1928, and Kentucky, which was twelfth in 1927, was tenth in 1928. These leading 10 States reported 81 per cent of the total in 1928, and the first five of them reported 57 per cent of the total. In each of these States, except Colorado and Georgia, sales of fire clay in 1928 constituted more than half of the total sales and ranged from 61 per cent of the total in California to 99 per cent in Missouri. Of the 43 States in which clay was sold in 1928, 27 reported increase in quantity and 21 reported increase in total value compared with 1927.

PRODUCTION BY USES

Statistics showing the production of clay by uses are necessarily incomplete, as many clay miners do not know the purpose to which their clay is put, but it is believed that the figures given in the following table are sufficiently complete to serve as a guide in the study of the uses of domestic clays. In considering these figures it should be borne in mind that they represent chiefly the clay sold as clay by the original producers and do not include the much greater quantities of clay that are burned into clay products by those who mine their own clay.

Clay sold by producers in the United States, 1927 and 1928, by uses, in short tons

Use	1927							1928						
	Kaolin	Ball clay	Slip clay	Fire clay	Stoneware clay	Miscellaneous clay	Total	Kaolin	Ball clay	Slip clay	Fire clay	Stoneware clay	Miscellaneous clay	Total
White-bodied ware made from white-burning clays	64, 578	60, 366		16, 764	1, 764		143, 472	59, 183	65, 465		8, 970	1, 371	25	135, 014
Art pottery	500	423		900	509	272	2, 604	7, 825	120		243		450	8, 638
High-grade tile	22, 790	29, 905		18, 639	568	3, 814	75, 716	21, 096	31, 854		24, 005	536	1, 639	79, 130
Chemical stoneware	76			963	7, 261	211	8, 511				1, 150	7, 763		8, 913
Stoneware		1, 078		2, 642	74, 594		78, 314		1, 046		5, 737	62, 741		69, 524
Enameling	26	708					734	7	540					547
Paper filler	192, 307					1, 201	193, 508	203, 235					160	203, 395
Paper coating	3, 510						3, 510	34, 000						34, 000
Rubber	27, 428			2, 305		842	30, 575	36, 654			1, 295		116	38, 065
Oilcloth or linoleum	14, 511						14, 511	13, 036						13, 036
Paint filler or extender	12, 084					1, 250	13, 334	15, 090			40		1, 239	16, 369
Paint pigment	14	331					345	35	508				100	643
Architectural terra cotta	100	9, 538		76, 538	12, 960	6, 480	105, 616	200	9, 000		80, 360	13, 233	3, 233	106, 026
Asbestos products	440	579				1, 364	2, 383	1, 627	3, 448		4, 815			9, 890
Plaster and plaster products	6, 224			11, 491		4, 075	21, 790	8, 466	57		7, 779			16, 302
Slip for glazing purposes			2, 478				2, 478			2, 137				2, 137
Cement	58, 594			1, 224			59, 818	45, 328			5, 438			50, 766
Kalsomine	3, 959						3, 959	1, 330			774			2, 104
Artificial abrasives		776	3, 659	3, 272	498	51	8, 256		56	3, 562	1, 202	1, 598		6, 418
Crayons	500						500	395						395
Chemicals	1, 500						1, 500							
Pencil leads						206	206							
Saggers	5, 304	15, 238		144, 210		300	165, 052	2, 674	6, 792		123, 854			133, 320
Pins, stilts, and spurs for potters' use	300			6, 346			6, 646	300			7, 574			7, 874
Wads				33, 463			33, 463		1, 015		29, 260			30, 275
Gas retorts				376			376				5, 028			5, 028
Fire brick and block	26, 629			921, 440		8, 295	956, 364	29, 487	160		1, 099, 738		3, 700	1, 133, 085
Fire-clay mortar	1, 871	426		461, 078			463, 375	2, 849			320, 284			323, 133
Bauxite and high alumina brick				10, 409		30	10, 439				499			499
Glasshouse pots				25, 184			25, 184	150			25, 091			25, 241
Glasshouse supplies, blocks, tiles, etc	295	242		1, 365			1, 902		145		1, 693			1, 838
Zinc retorts and condensers				79, 299			79, 299				60, 265			60, 265
Clay crucibles				3, 140			3, 140	150	344		2, 485			2, 979
Graphite crucibles and stoppers		108					108							
Foundries, steel works, etc	87			442, 292	65	39, 660	482, 104	5, 135			487, 700		26, 017	518, 852
Unspecified [1]	10, 618	45		436, 421	136	402, 864	850, 084	7, 890	328		479, 879	8, 384	486, 150	982, 631
	454, 245	119, 763	6, 137	2, 699, 761	98, 355	470, 915	3, 849, 176	496, 142	120, 878	5, 699	2, 785, 158	95, 626	522, 829	4, 026, 332

[1] 1927: Includes clay for blast furnaces, building brick, conduits, copper ladles, cosmetics, enameled brick, dobies, filtering or decolorizing oil, flower pots, flue lining, hollow building tile, modeling, mortar colors, roofing tile, sewer pipe, smelters, soap, taxidermy, toy marbles, turpentine cups, water softener, etc.; also black-burning clay. 1928: Includes clay for building brick, chimney tops, conduits, cosmetics, filler for cotton goods, filtering or decolorizing oil, flower pots, flue lining, hollow building tile, luting, matches, modeling, packing hoofs of horses, phonograph records, roofing tile, rotary drilling mud, sewer pipe, smelters, toy marbles, wall coping, waterproofing compound, and water softener: also black-burning clay.

IMPORTS AND EXPORTS[1]

Clay imported for consumption in the United States, 1919–1928

Year	Kaolin or china clay			Common blue and Gross Almerode glass-pot clay		All other clays				Total	
						Unwrought		Wrought			
	Short tons	Value		Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
		Total	Average								
1919	180, 592	$1, 965, 393	$10. 88	4	$133	23, 759	$187, 550	498	$4, 262	204, 853	$2, 157, 338
1920	361, 800	3, 568, 677	9. 86	6, 837	157, 201	34, 252	272. 524	691	10, 267	403, 580	4, 008, 669
1921	162, 906	1, 546, 285	9. 49	4, 468	77, 217	41, 421	348, 870	120	2, 313	208, 915	1, 974, 685
1922	310, 136	2, 963, 420	9. 56	7, 323	84, 415	40, 624	327, 388	2, 566	29, 398	360, 649	3, 404, 621
1923	311, 298	3, 046, 191	9. 79	12, 999	121, 272	65, 379	481, 614	1, 676	21, 892	391, 352	3, 670, 969
1924	353, 124	3, 188, 454	9. 03	7, 059	62, 883	82, 562	706, 018	1, 322	18, 685	444, 067	3, 976, 040
1925	372, 552	3, 195, 694	8. 58	11, 889	107, 940	49, 991	499, 325	2, 383	29, 266	436, 815	3, 832, 225
1926	396, 219	3, 484, 054	8. 79	6, 608	60, 391	84, 512	672, 223	2, 331	31, 243	489, 670	4, 247, 911
1927	339, 014	2, 937, 113	8. 66	3, 884	39, 451	50, 017	447, 888	1, 585	24, 518	394, 500	3, 448, 970
1928	307, 304	2, 962, 269	9. 64	10, 259	90, 742	51, 163	429, 788	1, 653	23, 564	370, 379	3, 506, 363

Domestic clay exported from the United States, 1919–1928

Year	Fire clay		All other		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1919	37, 486	$262, 501	30, 983	$249, 571	68, 469	$512, 072
1920	54, 125	393, 177	66, 035	775, 222	120, 160	1, 168, 399
1921	23, 666	177, 979	23, 779	183, 449	47, 445	361, 428
1922	24, 391	169, 664	[1] 23, 285	[1] 267, 908	47, 676	437, 572
1923	50, 055	303, 675	34, 840	329, 192	84, 895	632, 867
1924	41, 704	312, 676	31, 051	420, 040	72, 755	732, 716
1925	44, 037	350, 571	39, 006	530, 995	83, 043	881, 566
1926	47, 737	348, 302	42, 157	644, 416	89, 894	992, 718
1927	48, 106	392, 327	51, 278	725, 562	99, 384	1, 117, 889
1928	60, 138	494, 241	60, 911	896, 350	121, 049	1, 390, 591

[1] Includes 2,091 short tons of "kaolin, china, and paper clay," valued at $27,840. Similar exports are not separately classified for other years.

Imports of clay decreased 6 per cent in quantity but increased nearly 2 per cent in value in 1928 compared with 1927. Imports of kaolin or china clay, which constituted 83 per cent of the total quantity imported in 1928 and came chiefly from England, decreased 9 per cent in quantity but increased 1 per cent in value. The average value per ton of imported kaolin increased 98 cents and was the highest since that in 1923. The imports of high-grade refractory clay, entered under the classification "Common blue and Gross Almerode glass-pot clay," increased 164 per cent in quantity and 130 per cent in value compared with 1927. Imports classified as "Unwrought" clays, which are thought to include ball clays, increased slightly (2 per cent) in quantity but decreased 4 per cent in value compared with 1927.

The quantity of domestic clays exported increased 22 per cent in 1928 compared with 1927 and was the highest ever recorded; the value increased 24 per cent and was also the highest ever recorded. Fire clay, which constituted 50 per cent of the total quantity of clay exported in 1928 and 36 per cent of its value, increased about 25 per cent in both quantity and value compared with 1927.

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[1] Figures on imports and exports compiled by J. A. Dorsey, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.

TALC AND SOAPSTONE

By Oliver Bowles and B. H. Stoddard [1]

PRODUCTION

Sales of talc by producers in the United States during 1928 amounted to 202,976 short tons, valued at $2,537,994; they comprised 6,360 tons of crude talc, valued at $48,031; 936 tons of sawed and manufactured talc, valued at $70,394; and 195,680 tons of ground talc, valued at $2,419,569. Total sales in 1928 increased 5.5 per cent in quantity and 13.6 per cent in value over those in 1927. Crude talc increased 11.5 per cent in quantity and 89.4 per cent in value; sawed and manufactured talc decreased 37.3 per cent in quantity and 37 per cent in value; and ground talc increased 5.7 per cent in quantity and 15.3 per cent in value.

Massive soapstone is produced in Virginia but the Bureau of Mines is not at liberty to publish the figures.

Sales of talc and soapstone by producers over a series of years are shown in the following table.

Talc and soapstone sold by producers in the United States, 1919–1928, by classes

Year	Crude		Sawed and manufactured				Ground		Total	
			Talc		Soapstone					
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1919	15,625	$73,437	921	$147,339	16,504	$530,163	151,793	$1,601,736	184,843	$2,352,675
1920	11,008	43,820	1,415	139,335	19,707	709,400	178,505	2,142,894	210,635	3,035,449
1921	2,150	12,911	(1)	(1)	[1] 17,423	[1] 627,826	102,413	1,115,205	121,986	1,755,942
1922	4,981	22,582	654	86,333	22,700	712,144	170,349	2,038,838	198,684	2,859,897
1923	5,706	50,125	682	114,772	22,857	932,098	167,447	1,915,258	196,692	3,012,253
1924	5,710	22,247	846	109,405	25,630	1,288,885	171,635	2,095,019	203,821	3,515,556
1925 [2]	5,684	24,533	895	107,691	(3)	(3)	175,677	1,879,569	182,256	2,011,793
1926 [2]	5,988	26,723	1,528	130,253	(3)	(3)	174,052	1,954,018	181,568	2,110,994
1927 [2]	5,706	25,365	1,494	111,650	(3)	(3)	185,116	2,097,709	192,316	2,234,724
1928 [2]	6,360	48,031	936	70,394	(3)	(3)	195,680	2,419,569	202,976	2,537,994

[1] Talc included under "Soapstone."
[2] Figures represent talc only.
[3] Bureau of Mines not at liberty to publish figures for soapstone.

The quantity and value of talc sold by producers in 1926 to 1928, in the various forms in which it was marketed, are shown in the following table. As will be observed, only about 3 per cent of the total is sold in the rough or crude form as it comes from the mine and less than 1 per cent as cut pencils, crayons, or blanks for electrical or refractory uses, whereas 96 per cent is sold in finely pulverized form.

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[1] Figures on imports compiled by J. A. Dorsey, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.

Talc sold by producers in the United States, 1926–1928, by classes

Form in which sold	1926		1927		1928	
	Short tons	Value	Short tons	Value	Short tons	Value
Rough (crude)	5, 988	$26, 723	5, 706	$25, 365	6, 360	$48, 031
Sawed and manufactured [1]	1, 528	130, 253	1, 494	111, 650	936	70, 394
Ground [2]	174, 052	1, 954, 018	185, 116	2, 097, 709	195, 680	2, 419, 569
	181, 568	2, 110, 994	192, 316	2, 234, 724	202, 976	2, 537, 994

[1] For slate pencils and metal-worker's crayons and for blanks used in making acetylene burners and other objects.

[2] For filler in paper, paint, and rubber goods, and for toilet powder, foundry facings, textiles, lubricators, electric insulation, etc.

COMPOSITION AND PROPERTIES

Pure talc is a distinct mineral, a hydrous magnesium silicate, having a chemical composition represented by the formula $H_2Mg_3(SiO_3)_4$. It contains 31.7 per cent of magnesia (MgO), 63.5 per cent of silica (SiO_2), and 4.8 per cent of water (H_2O). Commercial talc is rarely pure as it contains varying quantities of clay, iron oxide, silica, calcite, and dolomite, together with sodium and potassium compounds. It occurs in fine granular, flaky, and, occasionally, fibrous form.

Its most pronounced and most easily recognizable physical properties are its softness, being easily scratched with the finger nail, and its soapy feel. It has superior properties of resisting and retaining heat, and it is also very resistant to the action of practically all acids and alkalies. It has high dielectric strength and is colloidal in finely ground form. It ranges in color from pure white through various shades of gray, green, and yellow.

The mineral pyrophyllite, a hydrous silicate of aluminum having the chemical formula $H_2Al_2(SiO_3)_4$, closely resembles talc in color, luster, and feel and is employed as a substitute for talc in many uses. It may, in fact, be superior to talc for some applications. It is claimed, for example, that it is better than talc as an admixture in plaster of Paris. The efflorescent stains on the surface of the plaster are commonly attributed to the presence of magnesium salts, and talc, being a magnesium silicate, might provide material for such salts. Pyrophyllite, having physical properties similar to those of talc, will condition and improve the working qualities of the plaster in much the same way as does talc, and, as pyrophyllite is an aluminum silicate, it will supply no magnesium.

USES

Dependence of use on physical properties.—The uses of talc and soapstone are governed to a greater extent by their characteristic physical properties than by their chemical composition. Thus the colloidal nature of finely ground talc makes it valuable as a filler in paper and other products, and its soft soapy feel makes it useful for the manufacture of toilet powders and cosmetics. The high electrical resistance of massive talc has led to its use in various electrical appliances. The heat resistance of soapstone renders it suitable for the manufacture of fireless cookers and linings for fireplaces, and its acid resistance is favorable to its use as acid-tank lining. Its easy workability adapts it to shaping into laundry tubs, sinks, and laboratory-table tops.

These are some of the more obvious ways in which physical characteristics adapt talc and soapstone to specific uses. As the use depends largely on the physical properties, it is evident that a detailed knowledge of the properties of various talcs is essential to obtaining the best possible service from them. Ignorance of the physical properties of a talc may lead to attempts to use it for purposes to which it is not adapted, resulting in damage to its prestige as a raw material. The more progressive talc producers realize that scientific research and standardization are necessary steps toward better utilization and consequent widening of market demands. Research should cover such properties as hardness, color, grain size, grain shape, slip, specific gravity, absorption, electrical resistance, and behavior under heat.

Uses enumerated.—High-grade ground talc is used extensively as a filler in paper, paint, rubber, textiles, and various other products; it is also used for foundry facings, lubricants, and various toilet preparations (such as talcum powder), in glass making, as a polishing agent for peanuts and rice, and in the manufacture of crayons and pencils. Large quantities of low-grade talc are used in the manufacture of composition roofing, both as a surface material to increase weather-resisting qualities and as a nonadhesive coating to prevent sticking; it is also used to prevent the sticking of rubber compounds to hot rollers.

High-grade massive talc of the variety known as "lava" grade, free from iron oxide and grit and without cracks or cleavage planes, is cut into gas tips, blanks for electric insulators, and spark plugs. The forms, easily shaped in the soft state in which massive talc is found in nature, are heated to a temperature of about 1,100° C. Such calcination has the peculiar effect of rendering the products hard enough to cut glass, and yet the expansion, contraction, or distortion resulting from the heating and subsequent cooling are so minute that the shapes, sizes, and even the accuracy of the milling remain unimpaired. Talc of this grade thus possesses a combination of qualities rarely found, namely, high dielectric strength, easy workability in the natural state, and an easily attained high degree of hardness without distortion on heating.

Massive soapstone is manufactured into laundry tubs, trays, sinks, laboratory-table tops, store fronts, bus-bar compartments, electric insulating material, acid tanks, stair treads, furnace blocks, fuse guards, tiles, aquariums, switchboards, panel boards, bases, insulators, wainscoting, fireless-cooker stones, hearth linings, furnace linings, and griddles.

Some interesting proposals have been made, having in view an extension of the uses of talc and pyrophyllite. It is claimed that these substances have some advantages over flint or quartz as components of electrical porcelain. The piezo-electric property of quartz, involving repeated minute volume changes when the mineral is subjected to an alternating current of electricity, has been advanced as an objection to the use of free quartz. The chief objection to free quartz in an electrical porcelain, however, is the deterioration that may result at high temperatures occasioned by the volume change at the inversion point of the α to the β form at 575° C.

It has been found that pyrophyllite added to clay for the manufacture of ceramic wares by the extrusion process acts as a lubricant for the dies, thus greatly reducing wear; the advantage gained, however, is not as great as was at first expected as pyrophyllite lacks binding power and the extruded body shows a tendency to fall apart.

Some progress has been made in the extension of the uses of talc for other purposes, such as the dusting of coal mines to prevent dust explosions and the conditioning of concrete.

REVIEW BY STATES

Talc is mined chiefly in New York and Vermont, and these two States produced more than 75 per cent of the total quantity in 1928. Smaller quantities were mined in 1928 in California, Georgia, Maryland, North Carolina, Pennsylvania, and Virginia.

The following table gives the quantity and value of the talc sold by producers in the various States in the past three years.

Talc sold by producers in the United States, 1926–1928, by States

State	1926		1927		1928	
	Short tons	Value	Short tons	Value	Short tons	Value
California	15, 419	$233, 292	15, 760	$238, 755	17, 830	$271, 413
Georgia	4, 220	89, 000	3, 110	42, 370	(1)	(1)
Maryland	2, 857	41, 780	(1)	(1)	(1)	(1)
New Jersey [2] and Pennsylvania	8, 097	74, 120	(1)	(1)	(1)	(1)
New York	83, 231	1, 030, 075	94, 553	1, 191, 453	107, 321	1, 504, 103
North Carolina	(1)	(1)	(1)	(1)	(1)	(1)
Vermont	53, 510	514, 527	54, 688	503, 716	52, 125	502, 501
Virginia	(1)	(1)	(1)	(1)	3, 997	37, 993
Undistributed	14, 234	128, 200	24, 205	258, 430	21, 703	221, 984
	181, 568	2, 110, 994	192, 316	2, 234, 724	202, 976	2, 537, 994

[1] Included under "Undistributed."

[2] No production from New Jersey in 1928.

California.—In 1928 sales of talc by producers in California increased 13 per cent in quantity and 14 per cent in value as compared with 1927. The sales in 1928 were made by five producers. Most of the talc mined in California is used for making talcum powder; the requirements for this purpose are freedom from grit or harmful impurities such as iron and lime, pure white or flesh color, and good slip. Some California talc, however, is used as a filler in paper, paint, soap, and rubber manufacture. The average value of the crude talc shipped was $6.50 a ton f. o. b. mines in 1928 and $6.35 in 1927; the average value of the ground talc was $16.64 a ton f. o. b. mills in 1928 and $17.24 in 1927. These were the only grades sold by producers in California in these years.

Georgia.—The Cohutta Talc Co. and the Georgia Talc Co. were the only producers of talc in Georgia in 1928. Most of the product was sold in ground form, but some was used in the manufacture of crayons of which there was a large increase in both quantity and value.

Maryland.—The total sales of talc by producers in Maryland increased in quantity but decreased in value as compared with 1927. Two producers reported sales in 1928—the Harford Talc Co. (Inc.), which mines a refractory talc, and Herbert I. Oursler, who shipped talc schist.

New York.—In 1928 New York again outranked all other States in the quantity and value of talc sold. Sales were made by the same producers as in 1927, namely, the Carbola Chemical Co. (Inc.), the

International Pulp Co., and the W. H. Loomis Talc Corporation. All the talc was sold in the ground form; it averaged about $14 a ton.

North Carolina.—The Standard Mineral Co. (Inc.) continued production in North Carolina from its mine near Hemp. The material mined is pyrophyllite rather than talc but it is applied to practically the same uses as talc. The deposits have been described in a recent report.[2]

Pennsylvania.—One producer in Pennsylvania sold talc in the ground form in 1928. Sales were in excess of the quantity sold in 1927.

Vermont.—In 1928 Vermont was again the second largest producer of talc in the United States. Sales by producers decreased slightly in both quantity and value compared with 1927. The talc was sold crude, manufactured (in the form of crayons), and ground. The bulk of the output, however, was used in the ground form by the paper, rubber, and roofing trades.

Virginia.—Talc was mined and shipped in Virginia in 1928 by the Blue Ridge Talc Co. (Inc.), the Bull Run Talc & Soapstone Co. (Inc.), and the Old Dominion Soapstone Co. The mill of the Blue Ridge Talc Co. (Inc.) was destroyed by fire in February, 1928, but a new mill of steel and concrete construction has been erected.

The Virginia Alberene Corporation continued the operation of the Schuyler soapstone quarries in Nelson County. This company has recently acquired the marble quarries of the Ross-Republic Marble Corporation of Knoxville, Tenn., and marble products are now being manufactured at Schuyler in conjunction with soapstone products. Soapstone was also produced, manufactured, and sold by the Standard Soapstone Corporation. The crude soapstone at both properties was manufactured and sold in the form of sinks, tubs, slabs, furnace blocks, floor tiles, electric disks, and laboratory equipment, and in many other specially shaped forms. A description of the soapstone deposits of Nelson County, Va., and the methods of mining has recently been published.[3]

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[2] Stuckey, J. L., The Pyrophyllite Deposits of North Carolina: North Carolina Dept. of Conservation and Development, Bull. 37, 1928.

[3] Ryan, C. W., Soapstone Mining in Virginia: Am. Inst. Min. and Met. Eng., Tech. Pub. 160, 1929.

LIST OF PRODUCERS

Producers of talc and soapstone in the United States in 1928

Name and address	Location of mine
CALIFORNIA	
American Italian Talc Co., 1407 East Sixth Street, Los Angeles.	9 miles west of Bigpine, Inyo County.
W. S. McLean, 1919 San Bruno Avenue, San Francisco	Butte County.
Pacific Coast Talc Co., 2149 Bay Street, Los Angeles	7 miles north of Silver Lake station, San Bernardino County.
Sierra Talc Co., 428 Union League Building, Los Angeles.	18 miles from Keeler, Inyo County.
Western Talc & Magnesite Co., 1901 East Slauson Avenue, Los Angeles.	Tecopa, Inyo County.
GEORGIA	
Cohutta Talc Co., Dalton	Chatsworth, Murray County.
Georgia Talc Co., Asheville, N. C	Foot of Cohutta Mountain, 3¼ miles southeast of Chatsworth, Murray County.
MARYLAND	
Harford Talc Co. (Inc.), 815 Continental Building, Baltimore.	Near Dublin, Harford County.
Herbert I. Oursler, Marriottsville	Near Henryton, Carroll County.
NEW YORK	
Carbola Chemical Co. (Inc.), Natural Bridge	1¼ miles from Natural Bridge, Lewis County.
International Pulp Co., 41 Park Row, New York City	Talcville, St. Lawrence County.
W. H. Loomis Talc Corporation, 173 East Main Street, Gouverneur.	Fowler, St. Lawrence County.
NORTH CAROLINA	
Standard Mineral Co. (Inc.), 230 Park Avenue, New York, N. Y.	2½ miles from Hemp, Moore County.
PENNSYLVANIA	
C. K. Williams & Co., 640 North Thirteenth Street, Easton.	Near Easton, Northampton County.
VERMONT	
American Soapstone Finish Co. (Inc.), Chester	2½ miles from Chester, Windsor County.
Eastern Magnesia Talc Co. (Inc.), Burlington	Johnson, Lamoille County, and Waterbury, Washington County.
Vermont Talc Co., Chester	Windham, Windham County.
VIRGINIA	
Blue Ridge Talc Co. (Inc.), Henry	Near Henry station, Franklin County.
Bull Run Talc & Soapstone Co. (Inc.), Clifton Station	3 miles north of Clifton, Fairfax County.
Old Dominion Soapstone Co., 815 Continental Building, Baltimore, Md.	Near Clifton, Fairfax County.
Standard Soapstone Corporation, 95 Liberty Street, New York, N. Y.	Near Arrington, Nelson County.
Virginia Alberene Corporation, 153 West Twenty-third Street, New York, N. Y.	Schuyler, Nelson County.

PRICES

In 1928 talc in the crude state was worth $2 to $30 a ton; the price of manufactured talc (talc crayons) ranged from about $55 to $275 a ton and that of ground talc from $5 to $20 a ton.

Soapstone in rough quarry blocks or in crude state is worth $3 to $10 a ton. When sawed into slabs and manufactured into laundry tubs, laboratory-table tops, and other products its value is greatly increased.

IMPORTS AND EXPORTS

Talc imported for consumption in the United States, 1919–1928

Year	Crude and unground steatite and French chalk		Manufactures (except toilet preparations) wholly or partly finished [1]		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1919	1, 641	$10, 105	12, 961	$248, 899	14, 602	$259, 004
1920	941	7, 206	21, 739	443, 514	22, 680	450, 720
1921	153	2, 279	11, 468	239, 469	11, 621	241, 748
1922	248	9, 850	18, 196	367, 528	18, 444	377, 378
1923	560	20, 653	19, 405	402, 238	19, 965	422, 891
1924	313	4, 847	17, 496	337, 508	17, 809	342, 355
1925	121	6, 547	20, 872	443, 985	20, 993	450, 532
1926	199	16, 366	23, 642	523, 716	23, 841	540, 082
1927	377	27, 326	24, 817	523, 056	25, 194	550, 382
1928	459	33, 276	26, 590	546, 639	27, 049	579, 915

[1] Prior to Sept. 22, 1922, the classification was "Talc, steatite, and French chalk—cut, ground, or washed."

Talc, ground or unground, imported into the United States, 1927–28, by countries

[General imports]

Country	1927		1928	
	Short tons	Value	Short tons	Value
Austria	88	$2, 750	76	$2, 000
Belgium	585	3, 023	430	2, 582
Canada	9, 599	112, 713	9, 761	118, 558
China	101	59, 832	121	63, 857
Czechoslovakia			111	2, 198
France	6, 278	89, 001	7, 605	100, 564
Germany	2	418	144	4, 776
Hong Kong	(1)	92	(1)	317
India (British)	155	8, 757	126	3, 217
Italy	8, 186	258, 083	8, 535	270. 301
Jamaica	19	289		
Japan	3	6, 354	3	4, 288
Netherlands			30	918
Spain	66	1, 522	43	1, 439
Switzerland	1	98		
United Kingdom	40	2, 353	23	1, 439
	25, 123	545, 285	27, 008	576, 454

(1) Less than 1 ton.

Exports of talc in bulk are not recorded. The exports of "talcum and other toilet powders" in 1922 amounted to 1,821 short tons, valued at $1,397,542; in 1923, 1,907 tons, valued at $1,671,588; in 1924, 1,614 tons, valued at $1,688,211; in 1925, 1,734 tons, valued at $1,882,196; in 1926, 1,645 tons, valued at $1,726,933; in 1927, 1,627 tons, valued at $1,621,068; and in 1928, 1,568 tons, valued at $1,605,630. Similar exports were not separately classified prior to 1922.

WORLD PRODUCTION

The following table gives the world production of talc and soapstone from 1924 to 1928, so far as figures are available. The relative importance of the various countries as producers may vary from year to year, but in recent years the United States has produced from 42 to 50 per cent, France 18 to 20 per cent, Italy 8 to 12 per cent, Germany and Austria 3 to 5 per cent, and Canada 2 to 4 per cent of the total world's output. The remainder is widely distributed among many countries.

World production of talc and soapstone, 1924–1928, by countries, in metric tons

[Compiled under supervision of L. M. Jones, of the Bureau of Mines]

Country [1]	1924	1925	1926	1927	1928
Australia:					
New South Wales	543	711	366	488	674
South Australia	330	358	560	629	641
Austria (exports)	9,587	12,883	13,846	(2)	(2)
Canada	10,280	13,131	14,304	14,988	[3] 13,540
Finland	--------	--------	--------	1,050	4,725
France	69,350	69,352	75,740	75,600	(2)
Germany (Bavaria)	3,997	3,461	3,834	6,381	7,872
Great Britain	--------	--------	--------	--------	164
Greece	139	94	151	213	30
India (British)	2,898	8,662	9,829	5,134	5,628
Italy	32,208	33,662	43,075	32,940	33,030
Japan [4]	41,867	44,094	(2)	(2)	(2)
Norway	11,785	9,032	7,608	7,607	7,822
Rumania	51	122	488	1,138	2,164
Russia [5]	(2)	569	2,995	2,118	(2)
Spain	1,977	1,771	1,658	3,843	5,302
Sweden	[6] 2,873	[6] 2,374	[6] 3,221	3,475	4,876
Union of South Africa (Transvaal)	575	60	76	294	541
United States	184,902	[7] 165,339	[7] 164,715	[7] 174,465	[7] 184,136
Uruguay (exports)	1,760	913	897	1,103	1,755

[1] In addition to the countries listed, Brazil produces a small quantity of talc, and China produces both talc and soapstone. No data of production are available for Brazil; exports of talc were reported as 120 kilograms in 1924 and 158 kilograms in 1925; no exports are reported for later years. China's output of talc in 1925 is officially estimated at 31,516 tons; similar data are not available for other years. No figures are available on the production of unmanufactured soapstone; the output of soapstone ware in 1925 is reported as 112 tons. (Hsieh, C. Y., Special Rept. No. 2, China Geol. Survey, Peking, 1926.)

[2] Data not available.

[3] Exclusive of soapstone for which value only is given.

[4] Includes agalmatolite.

[5] Year ended Sept. 30.

[6] Exclusive of a small quantity for which value only is given.

[7] Figures represent talc only. Bureau of Mines not at liberty to publish figures for soapstone.

TALC AND SOAPSTONE IN CANADA

The bulk of the ground talc produced in Canada comes from the Madoc district, Hastings County, Ontario, where deposits of foliated white talc have been worked for over 20 years. The talc is ground in local mills and is used in the talcum-powder, paper, textile, soap, and rubber industries. Domestic consumption is small, most of the product being exported, chiefly to the United States.

Block soapstone is produced in the Thetford district of Quebec. An important use of this soapstone is in the lining of furnaces in paper mills. Steps are being taken to market the waste material in ground form.

According to a report on "The Canadian Mineral Industry During 1928," issued by the Mines Branch, Department of Mines, the production of ground talc in 1928 amounted to 14,924 short tons, valued at $179,186, compared with 15,110 tons, valued at $178,931, in 1927. The output of block soapstone in 1928 was valued at $40,471. (These figures differ slightly from those used in the preceding table which are taken from the reports of the Dominion Bureau of Statistics.)

NATURAL GASOLINE

By G. R. Hopkins and E. M. Seeley

SUMMARY

The natural-gasoline industry continued to establish new records in 1928 when a total of 1,814,034,000 gallons was produced. (See fig. 2.) This output represents an increase of 11 per cent over 1927, as compared with an increase of 20 per cent in 1927 over 1926 and an annual increase of 21 per cent in both 1926 and 1925, and indicates a slowing down in activity and expansion to a point close to the average for the petroleum industry as a whole.

Natural-gasoline prices showed a distinct improvement in 1928 over the extremely low quotations in 1927. The main reason for this increase in prices was the comparative absence of "distress" product on the market; in other words, the supply of natural gasoline in 1928 was about equal to the demand. With regard to the relationship between the production of natural gasoline and the production of refinery gasoline (the straight-run and cracked products), the situation in 1928 was vastly different from that in 1927. The production of gasoline at refineries in 1927 represented an increase of 10 per cent over 1926 and the production in 1928 represented an increase of 15 per cent over 1927. On the other hand, the percentage of increase in output of natural gasoline in 1927 was nearly double that in 1928. This important change in the economic position of natural gasoline led to withdrawals from storage in 1928 and to a general betterment of conditions.

During 1928, 1,814,000,000 gallons of natural gasoline was produced and 5,000,000 gallons was withdrawn from storage, a total supply of 1,819,000,000 gallons. Of the total supply, 1,399,000,000 gallons, or 77 per cent, was reported as blended at refineries; 107,000,000 gallons, or 6 per cent, was turned into pipe lines and run to stills; 27,000,000 gallons, or 1.5 per cent, was blended at the plants; and 25,000,000 gallons, or 1.5 per cent, is estimated to have been blended by jobbers, leaving 261,000,000 gallons, or 14 per cent, for losses and quantities not accounted for. (See fig. 3.) These figures, compared with those for 1927, represent increases in use of natural gasoline by refiners

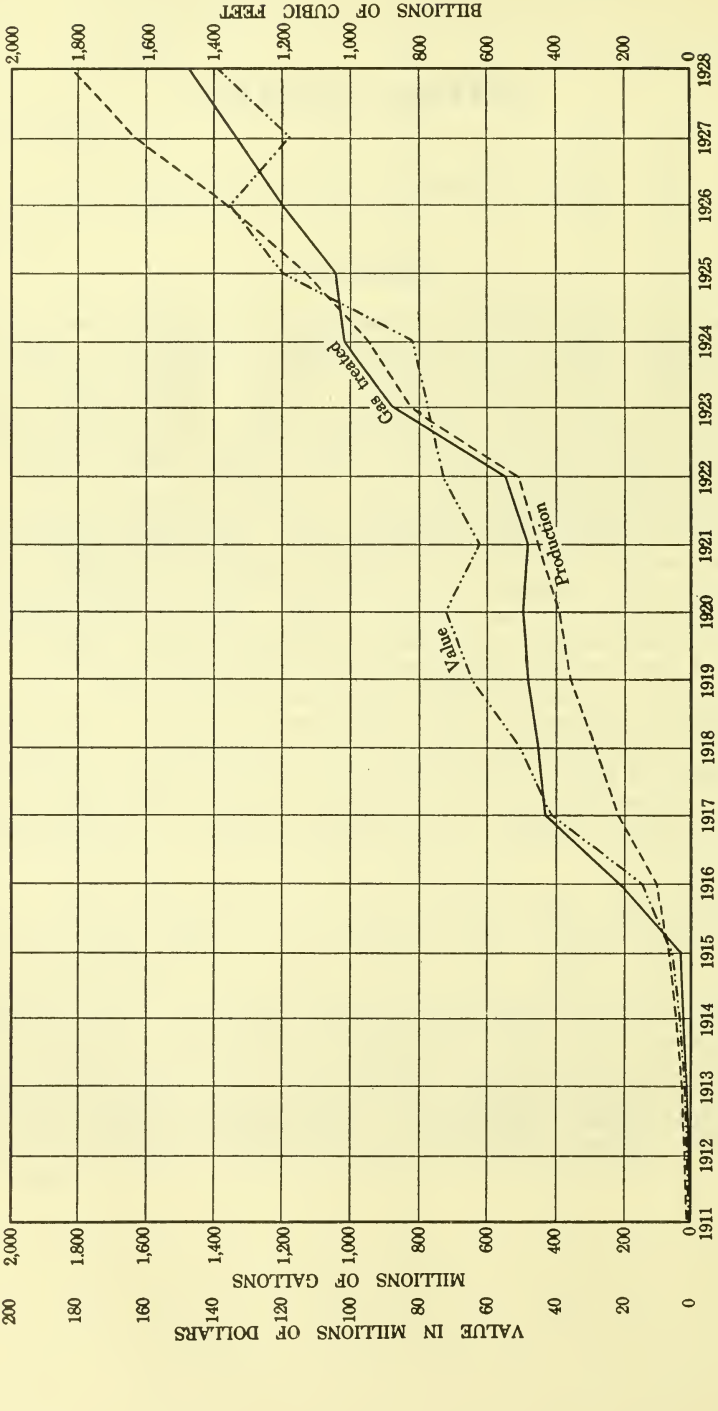

FIGURE 2.—Quantity and value of natural gasoline produced and volume of natural gas treated at plants, 1911–1928

and jobbers, but decreases in amounts run through pipe lines and blended by manufacturers at their plants.

Although natural-gasoline producers were favored by an increase in the demand for their product by refiners in 1928, they slackened their attempts little, if at all, to create new markets. The trend of modern refinery practice has been to get away from blending, which with the recent growth in vapor-phase cracking has given the natural-gasoline producer no chance for overconfidence. Although no data are available on the use of the lighter ends of natural gasoline for heating or in the chemical industry, it is probable that such consumption grew materially in 1928. A comparatively new development in the marketing of natural gasoline has occurred in the export trade. The use of natural gasoline as a blending material in the manufacture of the so-called export gasolines has been popular for some time, but such blending has usually been done in this country; only recently has the practice of shipping natural gasoline in bulk by tankers to foreign countries assumed importance. The demand for natural gasoline has been growing rapidly in the aviation industry and, in the absence of specific data on consumption, may be assumed to be increasing in proportion to the growth in number of aeroplanes.

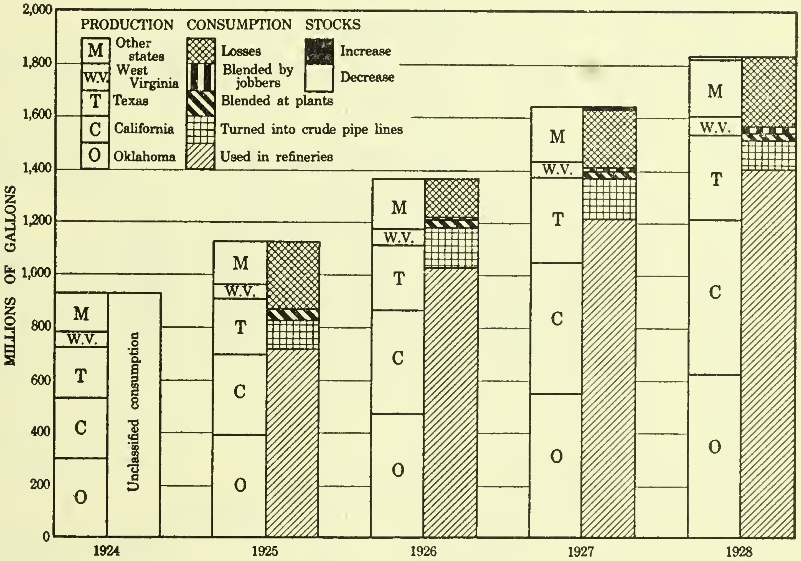

FIGURE 3.—Production and consumption of natural gasoline, 1924–1928

The influence of the flush production of petroleum in 1927 and the consequent building of natural-gasoline plants to utilize the natural gas produced with the crude oil spent itself in 1928, with the result that fewer plants were completed and the total for the country resumed its decline. The total number of operators in 1928 was 369 and the number of plants was 1,078, compared with 394 and 1,119, respectively, in 1927. Oklahoma continued to lead in the number of plants, having nearly twice the number of its nearest rival, Texas.

The average yield of natural gasoline per thousand cubic feet of gas treated for the industry as a whole amounted to 1.23 gallons in 1928, compared with 1.22 in 1927. This increase, while apparently negligible, is actually of considerable import, when the enormous quantities of gas treated are considered. The average yield in Oklahoma, the leading producing State, was 2.2 gallons in 1928, compared with 2.1 gallons in 1927; the yield in California was virtually unchanged; and the yield in Texas fell from 1.2 gallons in 1927 to 1 gallon in 1928. The decrease in Texas probably resulted from the operation of a number of new plants built to run on large quantities of lean gas. In general, the eastern States have the lowest yields. Illinois again led all the States in average yield, with a recovery of 2.6 gallons in 1928.

PRODUCTION

Natural gasoline produced in the United States, 1919–1928, by States, in thousands of gallons

Year	Arkansas	California	Colorado	Illinois	Kansas	Kentucky	Louisiana	New Mexico	New York
1919	--------	40,386	--------	6,060	3,284	5,136	10,063	--------	458
1920	--------	48,208	--------	6,055	4,331	4,497	10,610	--------	411
1921	--------	58,220	--------	7,536	3,587	4,242	15,341	--------	366
1922	4,289	67,120	--------	7,760	2,856	5,205	29,406	--------	506
1923	16,183	173,329	--------	7,356	8,775	7,601	40,720	--------	408
1924	17,533	232,579	--------	9,091	11,658	7,274	48,098	--------	477
1925	19,686	303,180	35	9,874	19,592	7,685	43,489	--------	414
1926	30,385	389,366	276	9,987	25,369	7,689	43,557	1,488	539
1927	37,498	498,020	912	8,853	36,095	7,480	44,844	1,827	449
1928	32,677	584,111	1,909	7,817	36,765	7,267	55,022	1,506	392

Year	Ohio	Oklahoma	Pennsylvania	Texas	West Virginia	Wyoming	Alaska	Total		
								Thousands of gallons	Value at plant	
									Thousands of dollars	Average per gallon (cents)
1919	8,801	189,995	20,284	9,337	52,150	5,581	--------	351,535	64,197	18.3
1920	10,016	178,857	21,151	32,956	58,941	8,711	--------	384,744	71,788	18.7
1921	9,100	185,341	19,856	77,141	54,646	14,558	--------	449,934	61,815	13.7
1922	8,600	189,404	18,518	95,405	56,796	19,967	--------	505,832	72,711	14.4
1923	10,035	270,249	19,132	177,765	63,381	21,292	--------	816,226	77,268	9.5
1924	9,443	301,062	19,254	186,571	61,549	29,272	--------	933,861	82,233	8.8
1925	8,701	390,861	18,850	214,092	58,201	32,777	33	1,127,470	120,383	10.7
1926	10,817	475,716	20,343	243,093	63,807	40,625	33	1,363,090	136,412	10.0
1927	12,167	548,109	16,744	320,723	64,192	43,212	19	1,641,144	118,688	7.2
1928	13,174	619,691	16,571	324,516	69,729	42,861	26	1,814,034	138,944	7.7

Natural gasoline produced and natural gas treated in the United States, 1927–28, by States

State	Number of operators reporting [1]	Number of plants	Raw (unblended) gasoline produced			Estimated quantity of natural gas treated	
			Thousands of gallons	Value at plant		Millions of cubic feet	Average yield per M cubic feet (gallons)
				Thousands of dollars	Average per gallon (cents)		
1927							
Alaska	1	1	19	2	10.5	15	1.3
Arkansas	12	16	37,498	2,281	6.1	20,566	1.8
California	50	152	498,020	52,436	10.5	332,676	1.5
Colorado	2	2	912	64	7.0	1,455	.6
Illinois	27	83	8,853	532	6.0	3,582	2.5
Kansas	15	25	36,095	1,746	4.8	28,906	1.2
Kentucky	10	12	7,480	547	7.3	27,994	.3
Louisiana	29	49	44,844	2,442	5.4	118,191	.4
New Mexico	1	1	1,827	109	6.0	998	1.8
New York	3	3	449	38	8.5	539	.8
Ohio	21	39	12,167	1,062	8.7	42,623	.3
Oklahoma	98	302	548,109	29,114	5.3	262,703	2.1
Pennsylvania	98	147	16,744	1,648	9.8	47,424	.4
Texas	57	152	320,723	18,347	5.7	265,699	1.2
West Virginia	44	125	64,192	5,421	8.4	152,297	.4
Wyoming	8	10	43,212	2,899	6.7	35,580	1.2
	[1] 394	1,119	1,641,144	118,688	7.2	1,341,248	1.2
1928							
Alaska	1	1	26	3	11.5	20	1.3
Arkansas	11	14	32,677	2,568	7.9	13,030	2.5
California	52	147	584,111	53,885	9.2	380,059	1.5
Colorado	2	2	1,909	136	7.1	3,498	.5
Illinois	23	78	7,817	585	7.5	2,999	2.6
Kansas	14	25	36,765	2,444	6.6	33,091	1.1
Kentucky	10	12	7,267	575	7.9	25,801	.3
Louisiana	27	49	55,022	3,434	6.2	129,513	.4
New Mexico	1	1	1,506	107	7.1	731	2.1
New York	3	3	392	45	11.5	411	1.0
Ohio	16	35	13,174	1,146	8.7	49,572	.3
Oklahoma	95	297	619,691	40,959	6.6	275,961	2.2
Pennsylvania	86	131	16,571	1,570	9.5	49,542	.3
Texas	57	156	324,516	22,492	6.9	309,769	1.0
West Virginia	42	118	69,729	6,220	8.9	164,120	.4
Wyoming	7	9	42,861	2,775	6.5	35,317	1.2
	[1] 369	1,078	1,814,034	138,944	7.7	1,473,434	1.2

[1] A producer operating in more than 1 State is counted only once.

The trend toward the absorption method of producing natural gasoline was continued in 1928, when a total of 1,563,929,000 gallons, or 86 per cent of the total, was produced by this method, as contrasted with 226,060,000 gallons, or 13 per cent, by the straight compression method and 24,045,000 gallons, or 1 per cent, by the charcoal process. The figures given above for absorption, however, include the production from plants that use the compression method or charcoal method combined with absorption.

The number of compression plants continued to decline; only 446 were in operation in 1928, compared with 490 in 1927. This decline, as in former years, was the result of the dismantling of small plants, principally in the eastern States, which have proven uneconomic at the prices prevailing for several years.

The number of absorption (including combined processes) plants increased from 599 in 1927 to 604 in 1928. Practically all of the new plants are in the Seminole area of Oklahoma and in Panhandle and north central Texas.

The number of charcoal plants declined from 30 to 28, but the total output of gasoline by this method continued its steady annual increase.

Natural gasoline produced in the United States, 1927–28, by States and by methods of manufacture

State	Number of plants			Raw (unblended) gasoline produced (thousands of gallons)		
	Compression	Absorption including combination absorption process with compression and charcoal processes	Charcoal	Compression	Absorption including combination absorption process with compression and charcoal processes	Charcoal
1927						
Alaska	----------	1	----------	----------	19	----------
Arkansas	3	12	1	2, 646	33, 353	1, 499
California	4	147	1	4, 718	492, 489	813
Colorado	----------	2	----------	----------	912	----------
Illinois	83	----------	----------	8, 853	----------	----------
Kansas	7	18	----------	7, 281	28, 814	----------
Kentucky	4	5	3	1, 228	5, 269	983
Louisiana	11	35	3	8, 135	35, 734	975
New Mexico	----------	1	----------	----------	1, 827	----------
New York	1	2	----------	132	317	----------
Ohio	22	15	2	600	9, 805	1, 762
Oklahoma	126	175	1	111, 621	436, 072	416
Pennsylvania	119	24	4	6, 061	9, 073	1, 610
Texas	42	107	3	48, 782	270, 170	1, 771
West Virginia	65	48	12	11, 468	40, 330	12, 394
Wyoming	3	7	----------	30, 274	12, 938	----------
	490	599	30	241, 799	1, 377, 122	22, 223
1928						
Alaska	----------	1	----------	----------	26	----------
Arkansas	1	11	2	2, 769	27, 484	2, 424
California	4	143	----------	3, 579	580, 532	----------
Colorado	----------	2	----------	----------	1, 909	----------
Illinois	78	----------	----------	7, 817	----------	----------
Kansas	7	18	----------	6, 872	29, 893	----------
Kentucky	3	6	3	1, 383	4, 973	911
Louisiana	10	36	3	8, 226	45, 881	915
New Mexico	----------	1	----------	----------	1, 506	----------
New York	1	2	----------	117	275	----------
Ohio	20	13	2	700	10, 671	1, 803
Oklahoma	111	185	1	106, 779	512, 800	112
Pennsylvania	106	23	2	5, 026	10, 752	793
Texas	38	115	3	40, 441	282, 850	1, 225
West Virginia	65	41	12	11, 781	42, 086	15, 862
Wyoming	2	7	----------	30, 570	12, 291	----------
	446	604	28	226, 060	1, 563, 929	24, 045

During 1928 natural gasoline was produced in 151 counties in 15 States, and also in Alaska. Many counties have only one plant and their production is relatively small, but a few counties near flush producing areas have expanded their output rapidly in recent years. Los Angeles County, Calif., which includes such fields as Santa Fe Springs, Long Beach, and Seal Beach, again led in quantity and value of output, producing 350,878,000 gallons, valued at $30,612,000, in 1928. Seminole County, Okla., ranked second in 1928 in quantity and value, producing 266,742,000 gallons, valued at $17,615,000, a gain over 1927 of 62 per cent in quantity and 105 per cent in value. Osage County, Okla., ranked third in quantity in 1928, and was followed in order by Creek County, Okla., and Orange and Ventura Counties, Calif.

Natural gasoline produced in the United States in 1928, by States and by counties

State	County	Thousands of gallons	Thousands of dollars
Alaska	Third division	26	3
Arkansas	Ouachita	9, 509	770
	Union	23, 168	1, 798
		32, 677	2, 568
California	Fresno	315	30
	Kern	63, 145	6, 913
	Los Angeles	350, 878	30, 612
	Orange	82, 116	8, 432
	Santa Barbara	7, 103	602
	Ventura	80, 554	7, 296
		584, 111	53, 885
Colorado	Larimer and Las Animas	1, 909	136
Illinois	Clark and Cumberland	654	53
	Crawford	2, 523	198
	Lawrence	4, 640	334
		7, 817	585
Kansas	Butler	4, 494	310
	Chautauqua, Montgomery, and Sedgwick	4, 005	317
	Cowley	7, 192	485
	Greenwood	12, 420	852
	Sumner	8, 654	480
		36, 765	2, 444
Kentucky	Boyd	2, 799	216
	Clark, Estill, and Wayne	698	61
	Floyd, Magoffin, and Menifee	340	28
	Lee	2, 084	163
	Martin	1, 346	170
		7, 267	575
Louisiana	Caddo	9, 933	716
	Claiborne	13, 516	978
	De Soto and Red River	1, 426	97
	Morehouse	3, 188	193
	Ouachita	11, 150	654
	Webster	15, 809	796
		55, 022	3, 434
New Mexico	Eddy	1, 506	107
New York	Allegany	392	45
Ohio	Athens, Hocking, Meigs, and Muskingum	976	84
	Cuyahoga, Lorain, Medina, and Wayne	2, 187	192
	Fairfield	1, 935	167
	Jefferson and Noble	473	41
	Licking	3, 862	334
	Monroe	486	43
	Richland	2, 713	234
	Washington	542	51
		13, 174	1, 146
Oklahoma	Carter	13, 140	901
	Creek	83, 053	5, 355
	Garfield	15, 447	1, 035
	Grady, Harmon, and Stephens	2, 082	127
	Grant and Logan	7, 345	408
	Hughes	8, 597	586
	Kay	34, 328	2, 320
	Lincoln	9, 558	622
	Muskogee	1, 054	71
	Noble	13, 727	636
	Nowata	2, 771	194
	Okfuskee	11, 384	722
	Okmulgee	10, 411	698
	Osage	99, 931	7, 010
	Pawnee	5, 504	373
	Payne	6, 800	460
	Pontotoc, Rogers, and Wagoner	1, 002	65
	Pottawatomie	17, 995	1, 158
	Seminole	266, 742	17, 615
	Tulsa	5, 976	413
	Washington	2, 844	190
		619, 691	40, 959

Natural gasoline produced in the United States in 1928, by States and by counties—Continued

State	County	Thousands of gallons	Thousands of dollars
Pennsylvania	Allegheny	1,912	183
	Armstrong, Beaver, and Lawrence	316	30
	Butler	493	45
	Clarion	427	43
	Crawford	164	15
	Elk and Potter	158	12
	Forest	736	67
	Greene	5,366	509
	McKean	1,263	121
	Venango	2,677	248
	Warren	2,026	190
	Washington	1,033	107
		16,571	1,570
Texas	Archer	2,847	203
	Brown	8,989	656
	Carson	15,960	1,188
	Clay	2,573	164
	Coleman and Erath	561	39
	Cooke, Throckmorton, and Wilbarger	5,318	312
	Eastland	60,691	4,206
	Freestone, Limestone, Navarro, and Williamson	5,970	442
	Gray	18,601	1,379
	Harrison, Panola, and Webb	1,223	46
	Howard, Mitchell, and Reagan	9,827	597
	Hutchinson	72,750	5,139
	Moore, Potter, and Wheeler	6,903	425
	Palo Pinto	6,218	351
	Shackelford	10,955	669
	Stephens	55,201	3,895
	Wichita	33,425	2,318
	Young	6,504	463
		324,516	22,492
West Virginia	Brooke and Marshall	729	59
	Cabell, Lincoln, and Wayne	3,985	313
	Calhoun, Gilmer, and Wirt	318	29
	Clay and Doddridge	360	31
	Harrison	2,369	207
	Jackson	6,784	554
	Kanawha	26,052	2,338
	Lewis	5,064	467
	Marion	3,047	280
	Monongalia	946	83
	Pleasants	1,115	100
	Ritchie	709	65
	Roane	3,194	262
	Tyler	2,524	231
	Wetzel	12,533	1,201
		69,729	6,220
Wyoming	Carbon and Niobrara	3,160	157
	Fremont and Hot Springs	944	86
	Natrona	38,757	2,532
		42,861	2,775
United States		1,814,034	138,944

STOCKS OF NATURAL GASOLINE AT PLANTS

Stocks of natural gasoline held at natural-gasoline plants declined from 32,226,000 gallons on January 1, 1928, to 27,161,000 gallons on December 31, 1928. This decline in stocks reflected in some measure the prosperity registered by the natural-gasoline industry in 1928.

Oklahoma showed the largest decline in natural-gasoline stocks and, with Ohio and Texas, accounted for nearly all the total decline for the country. In addition, manufacturers held 1,224,000 gallons of blended gasoline at natural-gasoline plants on December 31, 1928, a slight decrease from stocks on the first of the year.

Stocks at natural gasoline plants, January 1 and December 31, 1928, in thousands of gallons

State	Raw natural gasoline		Blended gasoline	
	Jan. 1	Dec. 31	Jan. 1	Dec. 31
Alaska		1	8	12
Arkansas	296	324	30	1
California	1, 449	1, 576	9	8
Colorado	34	12		
Illinois	217	197		
Kansas	723	981	12	18
Kentucky	122	119	17	7
Louisiana	898	1, 190		21
New Mexico	48	147		
New York	27	34	46	24
Ohio	750	193	9	21
Oklahoma	15, 911	11, 137	807	747
Pennsylvania	1, 100	802	139	143
Texas	8, 815	8, 387	131	156
West Virginia	1, 426	1, 565	36	66
Wyoming	410	496	88	
	32, 226	27, 161	1, 332	1, 224

NATURAL GASOLINE TURNED INTO PIPE LINES

The practice of transporting natural gasoline by means of crude petroleum pipe lines, which has grown steadily in recent years, fell off materially in 1928. The total quantity of natural gasoline turned into pipe lines, either in the raw state or mixed with crude or unfinished oils, amounted to 106,616,000 gallons in 1928, compared with 152,679,000 gallons in 1927. The chief reason for the decline in 1928 was the falling off of 43 per cent in the quantity of natural gasoline turned into pipe lines in California. California supplied 75 per cent of the total natural gasoline run into pipe lines in 1928, and is the only State in which the practice can be said to flourish. The quantity of natural gasoline turned into pipe lines in the Mid-Continent area increased considerably in 1928, particularly in the Panhandle district of Texas where natural gasoline is often used to facilitate the movement of viscous crude petroleum through the pipe lines.

Natural gasoline turned into crude-petroleum pipe lines in the United States, 1923–1928, by States, in thousands of gallons

State	1923	1924	1925	1926	1927	1928
Alaska			20	18	15	22
Arkansas				2, 188		
California	50, 398	87, 135	107, 771	138, 474	141, 500	80, 000
Illinois	26			12	3	4
Kansas				243	3, 172	5, 050
Kentucky				1		
Louisiana	3, 049	373	136		72	
Oklahoma	15, 418	1, 640	2, 065	8, 472	5, 701	8, 093
Pennsylvania	252					
Texas	3, 529	347	171	91	1, 658	13, 361
West Virginia	25				10	
Wyoming	1, 838			47	548	86
	74, 535	89, 495	110, 163	149, 546	152, 679	106, 616

NATURAL GAS TREATED

The utilized production of natural gas in the United States amounted to 1,568,139,000,000 cubic feet in 1928, an increase of 8.5 per cent over 1927. Of this total, 160,000,000 cubic feet were piped to Canada and Mexico, leaving 1,567,979,000,000 cubic feet for domestic consumption. The quantity of gas treated for the recovery of natural gasoline in 1928 was 1,473,434,000,000 cubic feet, or the equivalent of 94 per cent of the total gas produced, compared with 93 per cent of the total in 1927.

Natural gas produced and consumed in the United States and portion treated for recovery of natural gasoline, 1919–1928

	Produced and delivered to consumers (millions of cubic feet)	Consumed (millions of cubic feet)	Treated for recovery of gasoline (millions of cubic feet)	Ratio (percentage) of natural gas treated for gasoline—	
				To quantity produced and delivered to consumers	To quantity consumed
1919	745,916		480,404	64	
1920	798,210		496,431	62	
1921	662,052		465,097	70	
1922	762,546		545,139	71	
1923	[1] 1,006,976	1,006,967	875,711	87	87
1924	[2] 1,141,521	1,141,482	1,016,276	89	89
1925	[3] 1,188,571	1,188,439	1,040,390	88	88
1926	[4] 1,313,019	1,312,853	1,206,300	92	92
1927	[5] 1,445,428	1,445,244	1,341,248	93	93
1928:					
Arkansas	20,235	37,763	13,030	64	35
California [6]	246,215	246,215	380,059	154	154
Colorado [7]	2,931	6,347	3,498	119	55
Illinois	3,051	3,051	2,999	98	98
Kansas	45,644	72,671	33,091	72	46
Kentucky [8]	15,383	15,802	25,801	168	163
Louisiana	227,821	188,755	129,513	57	69
New Mexico	838	854	731	87	86
New York	[9] 7,224	17,918	411	6	3
Ohio	56,341	122,484	49,572	88	40
Oklahoma	320,861	285,333	275,961	86	97
Pennsylvania	99,466	116,150	49,542	50	43
Texas [6] [8]	[10] 301,990	318,718	309,769	103	97
West Virginia [11]	163,018	67,272	164,120	101	244
Wyoming	47,490	46,549	35,317	74	76
Other	9,631	22,097	20		
	[12] 1,568,139	1,567,979	1,473,434	94	94

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[1] Includes 9,000,000 cubic feet piped to Mexico.
[2] Includes 39,000,000 cubic feet piped to Canada and Mexico.
[3] Includes 132,000,000 cubic feet piped to Canada and Mexico.
[4] Includes 166,000,000 cubic feet piped to Canada and Mexico.
[5] Includes 184,000,000 cubic feet piped to Canada and Mexico.
[6] Large quantities of gas both before and after the recovery of gasoline were blown in the air or unaccounted for.
[7] A quantity of gas is returned to wells after being treated for gasoline.
[8] Quantities of natural gas were piped from other States, treated for gasoline recovery, and residue gas returned to State in which produced.
[9] Includes 84,000,000 cubic feet piped to Canada.
[10] Includes 76,000,000 cubic feet piped to Mexico.
[11] Natural gas was treated for gasoline recovery and consumed in other States.
[12] Includes 160,000,000 cubic feet piped to Canada and Mexico.

MONTHLY STATISTICS OF NATURAL GASOLINE

The preliminary figure for the total production of natural gasoline in 1928, as compiled from replies to monthly inquiries and shown in the following table, was 1,777,700,000 gallons. The chief reason for the difference between this figure and the final figure (1,814,034,000 gallons) is the fact that the annual canvass reaches a number of small plants not covered by the monthly inquiries.

The monthly production of natural gasoline in 1928 was fairly steady until September, from which time it increased rapidly to the end of the year largely because of stimulation by increased prices and the output resulting from new plants and extensions in the greater Seminole district. This district, second only to Los Angeles County as a producer of natural gasoline, was supposed to have reached its peak early in 1928, but the discovery of new pools and the production incident to the application of the gas-lift principle resulted in a material increase in output during the year.

The total production of motor fuel in 1928 was 16,001,600,000 gallons, of which 1,531,300,000 gallons, or 9.6 per cent, was natural gasoline. This figure compares with 10.1 (revised figure) per cent in 1927.

Summary of monthly (preliminary) natural gasoline and motor-fuel statistics in the United States in 1928, in millions of gallons

	January	February	March	April	May	June	July	August	September	October	November	December	The year
Natural gasoline:													
Production by fields—													
Appalachian	10.6	10.3	10.1	9.3	7.4	6.2	5.5	5.8	6.8	7.9	9.2	10.6	99.7
Kentucky and Illinois	1.3	1.3	1.4	1.3	1.2	1.0	.9	.9	1.0	1.2	1.2	1.5	14.2
Oklahoma—													
Seminole [1]	19.3	19.3	19.1	19.4	18.7	18.7	19.3	19.2	20.2	23.7	25.1	25.5	247.5
Osage County	8.4	8.4	9.0	8.2	8.5	8.2	8.0	8.0	8.1	8.2	7.6	8.1	98.7
Rest of State	22.7	23.0	23.8	22.8	22.5	21.9	22.2	21.3	21.6	22.2	22.7	23.4	270.1
Total Oklahoma	50.4	50.7	51.9	50.4	49.7	48.8	49.5	48.5	49.9	54.1	55.4	57.0	616.3
Kansas	2.6	2.8	2.9	3.2	3.1	3.0	2.8	2.9	2.9	3.0	3.2	3.3	35.7
Texas—													
Panhandle	7.7	7.4	7.6	8.5	8.7	8.6	8.7	9.0	10.3	11.6	12.1	12.3	112.5
North Texas	4.0	3.7	3.8	3.8	3.8	3.6	3.3	3.4	3.6	3.7	4.0	4.2	44.9
West central	13.2	13.0	14.0	13.0	13.2	12.3	12.7	12.6	12.8	13.7	13.0	13.2	156.7
Rest of State	1.3	1.4	1.5	1.4	1.5	1.4	1.4	1.4	1.4	1.4	1.3	1.5	16.9
Total Texas	26.2	25.5	26.9	26.7	27.2	25.9	26.1	26.4	28.1	30.4	30.4	31.2	331.0
Louisiana	4.2	4.3	4.5	5.0	4.8	4.3	4.5	4.5	4.7	4.8	4.8	5.1	55.5
Arkansas	2.5	2.5	2.7	2.8	2.9	2.8	2.8	2.8	2.7	2.7	2.6	2.7	32.5
Rocky Mountain	3.2	3.4	3.8	3.7	4.1	3.8	3.6	4.2	4.2	4.2	3.9	3.8	45.9
California—													
Long Beach	9.0	8.9	10.3	12.3	14.9	15.5	17.4	17.7	17.6	18.4	17.2	17.9	177.1
Ventura Avenue	6.3	5.3	5.4	5.5	5.5	5.0	5.6	5.5	4.8	5.8	5.3	5.5	65.5
Seal Beach	2.8	2.5	2.6	2.6	2.8	2.8	2.7	2.6	2.3	2.4	2.4	2.4	30.9
Huntington Beach	4.5	4.1	4.4	4.4	4.4	4.1	4.2	4.1	4.0	4.1	3.9	3.9	50.1
Santa Fe Springs	3.1	2.9	3.1	3.0	3.1	2.9	2.9	3.1	2.8	2.9	3.9	5.9	39.6
Rest of State	16.7	15.2	15.9	15.3	15.6	15.2	15.8	15.4	14.7	14.8	14.9	14.2	183.7
Total California	42.4	38.9	41.7	43.1	46.3	45.5	48.6	48.4	46.2	48.4	47.6	49.8	546.9
Total United States	143.4	139.7	145.9	145.5	146.7	141.3	144.3	144.4	146.5	156.7	158.3	165.0	1,777.7
Daily average	4.6	4.8	4.7	4.9	4.7	4.7	4.7	4.7	4.9	5.1	5.3	5.3	4.9
Indicated deliveries	143.1	136.2	145.1	146.0	147.6	148.1	151.5	147.0	145.6	158.1	158.2	156.5	1,783.0
Stocks at end of period	31.1	34.6	35.4	34.9	34.0	27.2	20.0	17.4	18.3	16.9	17.0	25.5	25.5
Blending at plants:													
Natural gasoline used [2]	2.1	2.3	2.5	2.6	2.3	2.4	2.5	1.9	1.7	1.9	2.2	2.3	26.7
Naphtha used [2]	3.2	3.3	3.4	3.2	3.4	3.1	3.0	2.3	2.1	1.8	2.6	2.9	34.3
Stocks of blends at end of period	1.2	1.2	1.1	1.3	1.2	1.2	1.1	.9	.9	.7	.9	1.1	1.1

Indicated output of motor fuel:													
Gasoline produced at refineries	1, 174. 4	1, 124. 0	1, 231. 0	1, 230. 6	1, 295. 1	1, 293. 3	1, 384. 3	1, 425. 4	1, 414. 2	1, 445. 4	1, 388. 8	1, 425. 2	15, 831. 7
Natural gasoline—													
Blended at plants [2]	2. 1	2. 3	2. 5	2. 6	2. 3	2. 4	2. 5	1. 9	1. 7	1. 9	2. 2	2. 3	26. 7
Sold to jobbers (estimate)	2. 1	2. 1	2. 1	2. 1	2. 1	2. 1	2. 1	2. 1	2. 1	2. 1	2. 1	2. 1	25. 2
Benzol produced [3]	9. 5	9. 1	10. 0	9. 6	10. 0	9. 7	9. 6	9. 8	9. 7	10. 3	10. 1	10. 6	118. 0
Total United States	1, 188. 1	1, 137. 5	1, 245. 6	1, 244. 9	1, 309. 5	1, 307. 5	1, 398. 5	1, 439. 2	1, 427. 7	1, 459. 7	1, 403. 2	1, 440. 2	16, 001. 6
Daily average	38. 3	39. 2	40. 2	41. 5	42. 2	43. 6	45. 1	46. 4	47. 6	47. 1	46. 8	46. 5	43. 7

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[1] Not including St. Louis-Pearson and Maud districts.

[2] Exclusive of California.

[3] Estimated with production of by-product coke as basis.

SPOT PRICES OF NATURAL GASOLINE

The weekly record of spot prices of grade A natural gasoline in Oklahoma reflected in a large measure the material improvement made by the industry in its economic position during 1928. The year opened with prices at the relatively low point of 5.25 cents per gallon, after which the market duplicated its 1927 performance of weakening prices in March and April and recovery in May. After that time the records for the two years bear little resemblance. For example, the average for August, 1928, was 10.69 cents, or nearly double that for August, 1927. During the last quarter of 1928 the price weakened, as was to be expected in view of the seasonal decline in gasoline consumption.

As the major portion of the total sales of natural gasoline is made on a contract basis, the increase in spot prices as an indicator of increased prosperity during 1928 should probably be considerably discounted. The chief value of the following record of spot prices, therefore, lies in the fact that it discloses the trend from week to week.

Spot price of Oklahoma natural gasoline, grade A, on specified dates, with monthly and yearly averages, 1927–28, in cents per gallon

[Oil and Gas Journal]

Date	Cents	Date	Cents
1927		1928	
Jan. 4	9.5	Jan. 3	5.25
Jan. 11	9	Jan. 10	5.25
Jan. 18	8.25	Jan. 17	5.38
Jan. 25	7.5	Jan. 24	5.5
Average	8.56	Jan. 31	5.38
Feb. 1	7.5	Average	5.35
Feb. 8	7.75	Feb. 7	5.25
Feb. 15	7.5	Feb. 14	5.5
Feb. 22	7	Feb. 21	5.5
Average	7.44	Feb. 28	5.5
Mar. 1	6.5	Average	5.44
Mar. 8	6.25	Mar. 6	5
Mar. 15	5.25	Mar. 13	5
Mar. 22	5	Mar. 20	4.75
Mar. 29	5	Mar. 27	4.5
Average	5.6	Average	4.81
Apr. 5	5	Apr. 3	4.13
Apr. 12	4.75	Apr. 10	4.75
Apr. 19	4.75	Apr. 17	5.75
Apr. 26	4.63	Apr. 24	6.25
Average	4.78	Average	5.22
May 3	4.63	May 1	6
May 10	5	May 8	5.5
May 17	5.75	May 15	6.38
May 24	6.13	May 22	6.38
May 31	6	May 29	5.5
Average	5.5	Average	5.95
June 7	5.5	June 5	6
June 14	5	June 12	6
June 21	4.75	June 19	5.75
June 28	4.5	June 26	6.38
Average	4.94	Average	6.03
July 5	4.5	July 3	6.88
July 12	4.5	July 10	7.38
July 19	4.88	July 17	8.5
July 26	5	July 24	9.5
Average	4.72	July 31	10.13
Aug. 2	5	Average	8.48
Aug. 9	5.5	Aug. 7	10.5
Aug. 16	6	Aug. 14	10.75
Aug. 23	6	Aug. 21	10.75
Aug. 30	6	Aug. 28	10.75
Average	5.7	Average	10.69
Sept. 5	5.75	Sept. 4	9.75
Sept. 13	5.5	Sept. 11	8.75
Sept. 20	6	Sept. 18	9.25
Sept. 27	6	Sept. 25	10
Average	5.81	Average	9.49

Spot price of Oklahoma natural gasoline, grade A, on specified dates, with monthly and yearly averages, 1927–28, in cents per gallon—Continued

Date	Cents	Date	Cents
1927		1928	
Oct. 4	6	Oct. 2	9. 5
Oct. 11	6	Oct. 9	10. 25
Oct. 18	6. 13	Oct. 16	9. 88
Oct. 25	6	Oct. 23	9. 63
Average	6. 03	Oct. 30	10. 13
Nov. 1	6	Average	9. 88
Nov. 8	5. 88	Nov. 6	9. 63
Nov. 15	5. 75	Nov. 13	9. 38
Nov. 22	5. 75	Nov. 20	8. 75
Nov. 29	5. 75	Nov. 27	9. 13
Average	5. 83	Average	9. 22
Dec. 6	5. 5	Dec. 4	9
Dec. 13	5. 38	Dec. 11	9
Dec. 20	5. 13	Dec. 18	8. 75
Dec. 27	5. 25	Dec. 26	8. 38
Average	5. 32	Average	8. 78
Average for the year	5. 84	Average for the year	7. 45

SILICA[1] [2]

INTRODUCTION

Silica (SiO_2) occurs in deposits of commercial importance in many different forms, such as vein quartz, as a constituent of pegmatites, as sand, sandstone, quartzite, or flint, as tripoli, and as diatomite or diatomaceous earth. In some forms, such as rose, smoky, and amethystine quartz, it has value as gems. This chapter deals with silica of all kinds except gem quartz, silica sand or sandstone used for making glass, and silica used in the form of sand, gravel, and crushed material for building, for concrete and mortar, for foundry and furnace work, and for cutting and grinding stone. Such material as is not included here is either gem material or sand, is commercially so designated, and is therefore considered in other chapters of Mineral Resources. Tripoli and diatomite were, in the past, largely consumed as abrasives and are considered in the chapter on abrasive materials; however, both are finding increasing markets for other than abrasive purposes. As it is impossible to separate the figures in order to show the quantities used for other purposes, the figures given here for diatomite and tripoli are duplicated in the abrasive chapter.

For a comprehensive discussion of the occurrence, mining or quarrying, methods of preparation, and uses of the various forms of silica the reader is referred to a recent report by W. M. Weigel, Technology and Uses of Silica and Sand, Bulletin 266, Bureau of Mines, 1927, which may be procured from the Superintendent of Documents, Government Printing Office, Washington, D. C., at 40 cents a copy.

PRODUCTION

The production of quartz (crude and ground) from pegmatite dikes, from veins, and from quartzite increased 0.2 per cent in quantity and 8 per cent in value in 1928, as compared with 1927. Ground sand and sandstone increased 2 per cent in quantity and 4 per cent in value.

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[1] Work on manuscript completed December, 1929.

[2] Statistics on production were prepared by Estelle R. Phillips, of the Bureau of Mines. Figures on imports were compiled by J. A. Dorsey, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.

Silica sold or used by producers in the United States for pottery, paints, fillers, polishers, abrasives, and other uses, 1926–1928

Material	1926		1927		1928	
	Short tons	Value	Short tons	Value	Short tons	Value
Quartz (vein quartz, pegmatite, and quartzite)	27,743	$274,333	22,144	$194,040	22,198	$209,333
Sand and sandstone [1]	270,468	1,928,793	275,737	1,897,303	280,402	1,966,296
Tripoli (including rottenstone) (ground and otherwise prepared)	31,369	523,609	26,099	447,068	34,043	555,576
Diatomite	87,126	1,081,564	(2)	(2)	(2)	(2)
	416,706	3,808,299	(2)	(2)	(2)	(2)

[1] Includes only finely ground material. Figures probably incomplete.
[2] Bureau of Mines not at liberty to publish figures.

QUARTZ

The States from which production of quartz (from pegmatite dikes, from veins, and from quartzite) was reported in 1928 were California, Maryland, Massachusetts, Nevada, New Hampshire, New York, North Carolina, Pennsylvania, Washington, and Wisconsin. California reported the largest production, with North Carolina and Maryland next in order. The mining of some crystal quartz for optical purposes was reported from California.

The total quantity of crude, crushed, and ground quartz sold or used by producers in 1928 amounted to 22,198 short tons, valued at $209,333. This output consisted of 11,951 tons of crude quartz, valued at $51,192; 3,412 tons of crushed quartz, valued at $28,037; and 6,835 tons of ground quartz, valued at $130,104.

Some of the crude material included in the foregoing figures was purchased by grinders who reported an additional production of 9,476 tons of ground quartz, valued at $197,577. This output of ground quartz, with the 6,835 tons reported by the original producers of the crude material, made a total of 16,311 tons of ground quartz, valued at $327,681.

Average values f. o. b. mines for the crude quartz reported by individual producers ranged from $2 to $8.60 a short ton, with an average sales value of $4.28 for the total quantity reported for the country. Corresponding values for crushed quartz ranged from $6.74 to $20 and averaged $8.22 a ton for the total output.

Average values of the ground quartz reported by individual producers ranged from about $5.50 to $30.58 a ton. The average sales value of all ground quartz considered here was $20.09 a ton. In 1928 production was reported by the following manufacturers of ground quartz, some using it in the manufacture of other products.

American Encaustic Tiling Co. (Ltd.), 2030 East Fifty-second Street, Los Angeles, Calif.
Baeder-Adamson Co., Philadelphia, Pa.
Behr-Manning Corporation, Troy, N. Y.
Erwin Feldspar Co. (Inc.), Erwin, Tenn.
Eureka Flint & Spar Co., Trenton, N. J.
Flynt Silica & Spar Co., 1047 Richmond Street, Los Angles, Calif.
Maryland Quartz Co., 73 Munsey Building, Baltimore, Md.
Northwest Mineral Products Co., Tacoma, Wash.
Oliver Quartz Co., Charlotte, N. C.

Spicky Polish Corporation, 214 Front Street, San Francisco, Calif.
Standard Flint & Spar Corporation, Trenton, N. J.
Standard Sanitary Manufacturing Co., Box W, Richmond, Calif.
Trenton Flint & Spar Co., Trenton, N. J.
United States Sandpaper Co., Williamsport, Pa.
Wausau Abrasives Co., Box 436, Wausau, Wis.

Companies that reported "crushed" (not "ground") material in 1928 were as follows:

The Enos Adams Co., Bennington, Vt. (mill at Adams, Mass.).
Cheshire White Quartz Sand Co., Cheshire, Mass.
San Jacinto Rock Products Co., San Jacinto, Calif.

Quartz sold or used by producers in the United States, 1919–1928

Year	Crude [1]		Ground [2]		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1919	51,774	$135,187	11,558	$238,384	63,332	$373,571
1920	59,423	142,397	8,767	177,953	68,190	320,350
1921	8,570	39,660	2,682	45,297	11,252	84,957
1922	5,085	23,093	5,568	78,254	10,653	101,347
1923	14,159	66,723	6,442	126,907	20,601	193,630
1924	20,570	123,099	3,191	80,078	23,761	203,177
1925	22,312	143,861	3,132	61,515	25,444	205,376
1926	22,230	159,052	5,513	115,281	27,743	274,333
1927	18,504	124,021	3,640	70,019	22,144	194,040
1928	15,363	79,229	6,835	130,104	22,198	209,333

[1] Includes some crushed quartz.
[2] In order to avoid duplication, the ground material shown here is only that ground by the original producers of the crude quartz or by grinders who purchase from small miners not reporting their production.

Quartz (crude, crushed, and ground [1]) sold or used by producers in the United States, 1926–1928, by States

State	1926		1927		1928	
	Short tons	Value	Short tons	Value	Short tons	Value
California	8,902	$103,016	6,755	$61,802	5,719	$47,789
Connecticut	246	1,678	--------	--------	--------	--------
Maine	328	1,050	(2)	(2)	--------	--------
Maryland	4,681	47,507	4,409	37,717	3,515	10,466
Nevada	2,292	12,125	1,030	6,180	(2)	(2)
New Hampshire	277	1,053	(2)	(2)	376	2,593
New York	2,135	13,121	520	2,597	(2)	(2)
North Carolina	2,134	17,457	3,396	19,853	4,113	40,128
Washington	(2)	(2)	273	2,070	(2)	(2)
Undistributed [3]	6,748	77,326	5,761	63,821	8,475	108,357
	27,743	274,333	22,144	194,040	22,198	209,333

[1] In order to avoid duplication, the ground material included is only that ground by the original producers of the crude quartz or by grinders who purchase from small miners not reporting their production.
[2] Included under "Undistributed."
[3] 1926: Massachusetts, Pennsylvania, Virginia, Washington, and Wisconsin; 1927: Maine, Massachusetts, New Hampshire, Pennsylvania, Virginia, and Wisconsin; 1928: Massachusetts, Nevada, New York, Pennsylvania, Washington, and Wisconsin.

GROUND SAND AND SANDSTONE

Ground sand and sandstone amounting to 280,402 short tons, valued at $1,966,296, was sold or used in 1928 by producers in California, Illinois, Missouri, New Jersey, Ohio, Pennsylvania, Virginia, West Virginia, and Wisconsin.

There is a great variation in the purity, fineness, and perfection of sizing of the ground sand and sandstone produced, which results in a wide range of average values for the output of the individual operators. This average ranged from $2.15 to $20.05 a ton in 1928. The average value for the total output of ground sand and sandstone was $7.01 a ton.

The following producers reported ground sand or sandstone in 1928.

Central Silica Co., Glass Rock, Ohio.
Clinch Mountain Silica Sand Corporation, Box 476, Richmond, Va.
Crystal Silica Sand Co., 716 East Sixtieth Street, Los Angeles, Calif.
Eureka Flint & Spar Co. Trenton, N. J.
Michigan Quartz Silica Co., Milwaukee, Wis.
National Pulverizing Co., Millville, N. J.
National Silica Co., Oregon, Ill.
National Silica Works, Berkeley Springs, W. Va.
New Jersey Pulverizing Co., 15 Park Row, New York, N. Y.
Ottawa Silica Co., Ottawa, Ill.
Pennsylvania Glass Sand Co. (grinds in New Jersey, Pennsylvania, and West Virginia), Lewistown, Pa.
Pioneer Silica Products Co., Pacific, Mo.
Potters Mining & Milling Co., East Liverpool, Ohio.
Standard Flint & Spar Corporation, Trenton, N. J.
Trenton Flint & Spar Co., Trenton, N. J.
Wedron Silica Co., First National Bank Building, Chicago, Ill.

Ground sand and sandstone sold or used by producers in the United States, 1919–1928 [1]

Year	Short tons	Value	Year	Short tons	Value
1919	47,277	$288,890	1924	230,432	$1,655,056
1920	158,395	1,183,014	1925	263,981	1,857,263
1921	105,887	802,450	1926	270,468	1,928,793
1922	163,295	1,061,057	1927	275,737	1,897,303
1923	249,467	1,672,961	1928	280,402	1,966,296

[1] Includes only finely ground material. Figures probably incomplete.

Ground sand and sandstone sold or used by producers in the United States, 1927–28, by States [1]

	1927		1928	
	Short tons	Value	Short tons	Value
Illinois and Missouri	84,925	$476,007	81,883	$523,373
New Jersey	86,361	460,347	84,786	403,813
Virginia and West Virginia	54,335	481,434	56,603	504,383
California, Ohio, Pennsylvania, and Wisconsin	50,116	479,515	57,130	534,727
	275,737	1,897,303	280,402	1,966,296

[1] Includes only finely ground material. Figures probably incomplete.

IMPORTS

Data on imports of silica materials are found in the records of the Bureau of Foreign and Domestic Commerce under the classifications "silica, crude," "silica, for use as pigment," and "flint, flints, and flint stones, unground." There were no imports of crude silica recorded for 1928. Imports of crude silica were reported for 1927 from the Philippine Islands and amounted to 12 short tons, valued at

$175. Imports of crude silica reported for 1926 were 27 tons, valued at $149; for 1925, 22 tons, valued at $486. Imports of silica for use as pigment amounted to 22 short tons, valued at $535, in 1927; none were separately recorded for 1928, 1926, or 1925. The imports of "flint, flints, and flint stones, unground," are flint pebbles for grinding mills and for other uses such as are listed in this report; they amounted to 15,719 short tons valued at $144,313 in 1928, 15,191 tons valued at $93,658 in 1927, 15,091 tons valued at $120,078 in 1926, and 16,240 tons valued at $105,041 in 1925.

The imports of "flint, flints, and flint stones, unground," from France in 1928 amounted to 50 per cent of the total quantity imported; from Denmark 43 per cent; and from Belgium 6 per cent. The balance came from "Other Netherland East Indies," Sweden, Canada, the United Kingdom, and Germany. The average value for these imports ranged from $5.09 per short ton for the material from the United Kingdom to $22.35 per ton for the material from Germany. The average value of the whole quantity imported was $9.18.

The values assigned to the imports considered in the following tables are those upon which the import duties in the United States are levied and represent the foreign market value (or the export value, if higher) plus cost of containers and all expenses incident to placing merchandise ready for shipment to the United States, including export tax, if any.

"Flint, flints, and flint stones, unground," imported for consumption in the United States, 1919–1928

Year	Short tons	Value	Year	Short tons	Value
1919	19,798	$250,096	1924	17,473	$114,958
1920	26,636	338,630	1925	16,240	105,041
1921	10,084	116,157	1926	15,091	120,078
1922	16,040	145,805	1927	15,191	93,658
1923	15,952	130,974	1928	15,719	144,313

"Flint, flints, and flint stones, unground," imported into the United States, 1926–1928, by countries

Country	1926		1927		1928	
	Short tons	Value	Short tons	Value	Short tons	Value
Algeria and Tunisia	104	$477	--------	--------	--------	--------
Belgium	1,680	24,924	1,089	$14,513	969	$18,379
Canada	3	23	--------	--------	44	384
Denmark	3,454	39,120	3,148	24,812	6,716	74,595
France	9,475	52,522	10,953	54,307	7,816	49,190
Germany	--------	--------	--------	--------	20	447
Netherland East Indies, "Other"	--------	--------	--------	--------	61	470
Sweden	--------	--------	1	26	59	675
United Kingdom	375	3,012	--------	--------	34	173
	15,091	120,078	15,191	93,658	15,719	144,313

BARITE AND BARIUM PRODUCTS

By R. M. SANTMYERS AND B. H. STODDARD [1]

CRUDE BARITE

SALES

The quantity of crude barite sold or used by producers during 1928 showed a substantial increase over 1927 and represents the largest annual output ever recorded. The average value per ton f. o. b. mine of barite sold in 1928 was, however, the lowest since 1917, and was 6 cents less than that in 1927.

Crude barite sold or used by producers in the United States, 1919–1928

Year	Short tons	Value f. o. b. at mine		Year	Short tons	Value f. o. b. at mine	
		Total	Average			Total	Average
1919	209, 330	$1, 727, 822	$8. 25	1924	196, 332	$1, 540, 744	$7. 85
1920	228, 113	2, 142, 464	9. 39	1925	228, 063	1, 703, 097	7. 47
1921	66, 369	531, 958	8. 02	1926	237, 875	1, 773, 293	7. 45
1922	155, 040	1, 123, 950	7. 25	1927	254, 265	1, 670, 878	6. 57
1923	214, 183	1, 664, 156	7. 77	1928	269, 544	1, 754, 924	6. 51

Georgia showed the largest gain in sales of crude barite, increasing 19 per cent over sales in 1927; the average value per ton, however, fell from $6.17 in 1927 to $6.01 in 1928. The increase in production was due partly to increased demand for crude barite by consumers in the East. Missouri increased its sales from 111,456 short tons in 1927 to 114,274 tons in 1928; the average value per ton, however, followed the general trend and decreased from $7.15 in 1927 to $7.09 in 1928. Tennessee and California both showed declines in sales in 1928 compared with 1927. Georgia's share of the total sales increased from 37 per cent in 1927 to 42 per cent in 1928, whereas Missouri's share decreased from 44 to 42 per cent, Tennessee's from 8 to 7.5 per cent, and California's from 6 to 5 per cent. The average value per ton f. o. b. mine in 1928 ranged from $4.10 in California to $7.45 in Tennessee; the corresponding range in 1927 was from $5.15 per ton in California to $7.15 in Missouri.

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[1] Figures on imports and exports compiled by J. A. Dorsey, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.

Crude barite sold or used by producers in the United States, 1927–28, by States

State	1927				1928			
	Short tons	Percentage of total	Value f. o. b. at mine		Short tons	Percentage of total	Value f. o. b. at mine	
			Total	Average			Total	Average
California	13,919	6	$71,708	$5.15	12,557	5	$51,502	$4.10
Colorado	----------	--------	------------	----------	40	--------	340	8.50
Georgia	94,039	37	580,300	6.17	112,316	42	675,509	6.01
Missouri	111,456	44	797,465	7.15	114,274	42	810,203	7.09
Nevada	884	--------	3,969	4.49	----------	--------	------------	----------
Tennessee	20,537	8	129,999	6.33	20,260	7	150,937	7.45
Other States [1]	13,430	5	87,437	6.51	10,097	4	66,433	6.58
	254,265	100	1,670,878	6.57	269,544	100	1,754,924	6.51

[1] South Carolina, Virginia, and Wisconsin.

STOCKS AT MINES

The apparent stock of crude barite on hand at mines at the end of December, 1928, was about 38,000 short tons, of which about 18,500 tons was held in Georgia and about 17,000 tons in Missouri. These stocks do not include the crude barite held at chemical, lithopone, and grinders' plants, as such lots are considered marketed product.

CONSUMPTION BY USES

Twenty-five plants distributed among 11 States used 334,695 short tons of domestic and imported crude barite in 1928. Additional plants went into operation in Missouri and California, whereas Pennsylvania had one plant less in operation than in 1927. Missouri, with 4 plants, used 76,032 tons for the manufacture of ground barite and barium chemicals; New Jersey, with 3 plants, used 55,454 tons for the manufacture of lithopone and chemicals; Pennsylvania, with 2 plants, used 47,433 tons for the manufacture of lithopone and chemicals, an increase of 5,303 tons over the quantity used by 3 plants in 1927; and Illinois, with 6 plants, used 68,340 tons for the manufacture of lithopone and chemicals. Virtually all of the imported crude barite was used in the Atlantic Coast States.

Crude barite (both domestic and imported) used in the manufacture of barium products in the United States, 1919–1928, in short tons

Year	In manufacture of—			Total
	Ground barite	Lithopone	Barium chemicals	
1919	64,922	103,688	32,976	201,586
1920	79,052	113,181	37,210	229,443
1921	28,296	61,359	10,952	100,607
1922	48,280	94,259	25,303	167,842
1923	47,713	128,547	34,327	210,587
1924	42,855	137,127	33,181	213,163
1925	56,851	146,693	29,141	232,685
1926	69,048	178,889	33,119	281,056
1927	73,119	222,791	34,280	330,190
1928	74,814	211,592	48,289	334,695

Domestic and imported crude barite used in the manufacture of barium products in the United States in 1928, by States

State	Product manufactured	Plants[1]	Barite used
			Short tons
Illinois	Lithopone and chemicals	6	68,340
Missouri	Ground barite and chemicals	4	76,032
New Jersey	Lithopone and chemicals	3	55,454
Pennsylvania	do	2	47,433
California	Ground barite, lithopone, and chemicals	4	14,243
Delaware and Maryland	Lithopone	2	73,193
Georgia	Ground barite	1	
New York	Chemicals	1	
South Carolina	Ground barite	1	
West Virginia	Chemicals	1	
		25	334,695

[1] A plant producing more than one product is counted but once in arriving at total.

IMPORTS

Imports of barite from Germany still play an important rôle in the American barite industry, furnishing the Atlantic Coast States with a large part of their requirements. The total amount of crude barite imported for consumption during 1928 was 61,765 short tons, valued at $190,756, or an average of $3.09 per ton. As compared with 1927, these imports represent decreases of 8,509 tons and $62,528. The average declared value at foreign port of shipment decreased 51 cents a ton, as compared with a decline of only 6 cents a ton in the average obtained for domestic ore f. o. b. mine.

Crude barite imported for consumption in the United States, 1919–1928

Year	Short tons	Value[1]		Year	Short tons	Value[1]	
		Total	Average			Total	Average
1919	118	$594	$5.03	1924	21,502	$104,264	$4.85
1920	24,874	146,858	5.90	1925	28,655	91,016	3.18
1921	11,054	59,371	5.37	1926	51,016	195,004	3.82
1922	23,239	104,680	4.50	1927	70,274	253,284	3.60
1923	15,045	93,721	6.23	1928	61,765	190,756	3.09

[1] Value at port of shipment, on which duty is levied. Does not include railroad and ship freight charges to this country or import duty.

WORLD PRODUCTION

The following table shows the output of barite by various countries from 1924 to 1928, as far as statistics are available.

World production of barite, 1924–1928, in metric tons

[Compiled under supervision of L. M. Jones, of the Bureau of Mines]

Country	1924	1925	1926	1927	1928
Algeria	500	600	800	500	(1)
Australia:					
New South Wales	152	203	203	203	20
South Australia	1,928	2,040	1,770	1,916	2,404
Tasmania	----------	4	----------	----------	----------
Austria	1,399	1,363	966	1,924	2,243
Belgium	20,490	13,190	6,100	1,630	(1)
Canada	137	86	91	51	115
France	44,189	41,450	38,810	(1)	(1)
Germany:					
Bavaria	23,029	21,477	26,955	20,035	23,872
Prussia	102,326	151,243	135,319	154,794	(1)
Saxony	2,076	968	----------	----------	(1)
Great Britain	55,646	49,462	43,462	47,605	50,702
India (British)	2,340	1,473	2,348	1,747	3,146
Italy	39,568	32,195	31,845	30,677	27,116
Rhodesia, Southern	64	36	27	13	77
Russia [2]	737	4,684	14,389	8,496	(1)
Spain [3]	14,450	8,784	7,941	7,716	6,163
United States	178,108	206,894	215,795	230,664	244,525

[1] Data not available.
[2] Year ended Sept. 30.
[3] Includes the following quantities reported produced from quarries: 1924, 7,682 tons; 1925, 78 tons; 1926, 690 tons; 1927, 2,760 tons; 1928, 2,300 tons.

BARIUM PRODUCTS

The total quantity of barium products manufactured and sold was 16 per cent larger in 1928 than in 1927; the total value increased 13 per cent. Ground barite showed a gain of 12 per cent in quantity, lithopone 13 per cent, and barium chemicals 42 per cent, and the corresponding increases in values were: Ground barite, 14 per cent; lithopone, 11 per cent; and barium chemicals, 35 per cent.

Barium products made from domestic and imported crude ores in the United States and sold, 1927–28

Product	1927			1928		
	Short tons	Value		Short tons	Value	
		Total	Average		Total	Average
Ground barite	57,658	$1,166,294	$20.23	64,425	$1,332,228	$20.68
Lithopone	176,994	17,163,620	96.97	200,468	19,073,914	95.15
Barium chemicals [1]	23,943	1,517,994	----------	33,969	2,045,156	----------
	258,595	19,847,908	----------	298,862	22,451,298	----------

[1] Barium chemicals manufactured from barium products bought in open market are not included in table in order to avoid duplication; the total output of barium chemicals is therefore not shown above.

REFINED GROUND BARITE

Total sales of ground barite by producers during 1928 amounted to 64,425 short tons, valued at $1,332,228, an increase of 12 per cent in quantity and 14 per cent in value over 1927. The average value per ton increased from $20.23 in 1927 to $20.68 in 1928. Missouri continued to be the center of the grinding industry, using 63,294 short tons of crude barite for this purpose in 1928.

Ground barite sold by producers in the United States, 1919–1928

Year	Number of plants	Short tons	Value		Year	Number of plants	Short tons	Value	
			Total	Average				Total	Average
1919	9	[1] 57,985	[1] $1,163,437	$20.06	1924	5	38,296	$784,881	$20.50
1920	8	65,748	1,381,868	21.02	1925	5	49,674	1,040,461	20.95
1921	7	27,661	622,871	22.52	1926	5	57,812	1,186,563	20.52
1922	7	46,176	933,722	20.22	1927	7	57,658	1,166,294	20.23
1923	6	39,605	895,095	22.60	1928	8	64,425	1,332,228	20.68

[1] Figures cover production, not sales.

LITHOPONE

Lithopone manufacturers established a new high record in 1928 in quantity sold. Prices held steady throughout the year. Toward the close of the year, with the zinc market on the upgrade, a possibility of a rise in prices of the pigment was in view; no increase materialized, however, and business for the early part of 1929 was booked on the same price basis that prevailed for the last seven months of 1928. Makers of lithopone anticipate a continued widening market for their product and are planning for larger production.

During the year 12 plants were in operation and shipped 200,468 short tons, valued at $19,073,914, an increase of 13 per cent in quantity and 11 per cent in value compared with 1927. The average value per ton decreased from $96.97 in 1927 to $95.15 in 1928.

Lithopone sold by producers in the United States, 1919–1928

Year	Number of plants	Short tons	Value		Year	Number of plants	Short tons	Value	
			Total	Average				Total	Average
1919	15	78,365	$10,218,850	$130.40	1924	11	109,469	$12,531,397	$114.47
1920	17	89,373	12,484,925	139.69	1925	11	145,019	15,186,147	104.72
1921	15	55,016	6,681,563	121.45	1926	13	159,931	16,062,197	100.43
1922	13	83,360	9,214,040	110.53	1927	13	176,994	17,163,620	96.97
1923	11	98,199	11,608,443	118.21	1928	12	200,468	19,073,914	95.15

GROWTH OF USE OF BARIUM PIGMENTS

The use of barium sulphate for the manufacture of lithopone, a white paint pigment consisting of a mixture of approximately 70 per cent of barium sulphate and 30 per cent of zinc sulphide, is increasing rapidly. In 1918 the producers sold 62,403 short tons of lithopone. The amount sold increased annually until 1921 when, as a result of business depression throughout the country, it fell to 55,016 tons. Since then sales have advanced steadily, and 200,468 tons of lithopone was sold in 1928. Sales of barium sulphate (blanc fixe) increased from 9,522 short tons in 1918 to 13,395 tons in 1927, and continued to increase in 1928.

The other principal white pigments, those manufactured from lead and zinc, have not paralleled the growth of barium pigments in recent years. With the exception of the sharp decline in 1920 and 1921 sales of zinc white pigments have been increasing, although not as rapidly as sales of barium pigments. On the other hand, sales of lead white pigments increased from about 110,000 short tons in 1918 to over 200,000 tons in 1922 but fell off thereafter and amounted to about 170,000 tons in 1928.

Barium, lead, and zinc pigments sold by producers in the United States, 1919–1928, in short tons

Year	Lithopone	Barium sulphate (blanc fixe)	Lead pigments [1]	Zinc pigments [2]
1919	78,365	5,227	148,158	145,230
1920	89,373	8,046	158,107	129,904
1921	55,016	2,471	181,851	90,432
1922	83,360	7,349	208,756	148,078
1923	98,199	6,761	174,822	150,491
1924	109,469	7,796	202,066	158,199
1925	145,019	11,748	178,901	183,104
1926	159,931	(3)	162,084	170,782
1927	176,994	13,395	171,177	177,310
1928	200,468	(3)	169,974	185,127

[1] White lead (dry and in oil) and white lead sulphate.
[2] Zinc oxide and leaded zinc oxide.
[3] Bureau of Mines not at liberty to publish figures.

BARIUM CHEMICALS

In 1928 the total sales of barium chemicals by first producers from bariten icreased 42 per cent in quantity over 1927. The value of these sales increased from $1,517,994 in 1927 to $2,045,156 in 1928, or 35 per cent. Sales of barium carbonate increased from 5,969 short tons, valued at $313,613, in 1927 to 7,626 tons, valued at $416,227, in 1928; the average value per ton increased from $52.54 to $54.58. Sales of barium chloride increased from 3,708 tons, valued at $213,446, in 1927 to 5,224 tons, valued at $301,490, in 1928; the average value increased from $57.56 to $57.71.

Barium chemicals sold by producers in the United States, 1927–28

Chemical	1927			1928		
	Short tons	Value		Short tons	Value	
		Total	Average		Total	Average
Barium carbonate	5,969	$313,613	$52.54	7,626	$416,227	$54.58
Barium chloride	3,708	213,446	57.56	5,224	301,490	57.71
Barium sulphate (blanc fixe)	13,395	876,842	65.46	21,119	1,327,439	62.86
Other [1]	871	114,093	131.00			
	23,943	1,517,994	----------	33,969	2,045,156	----------

[1] Binoxide, hydroxide, and sulphide.

Barium chemicals sold by producers in the United States, 1919–1928, in short tons

Year	Barium carbonate	Barium chloride	Barium sulphate (blanc fixe)	Other barium chemicals [1]	Year	Barium carbonate	Barium chloride	Barium sulphate (blanc fixe)	Other barium chemicals [1]
1919 [2]	7,135	4,509	5,227	3,142	1924	6,058	3,859	7,796	441
1920	7,484	3,084	8,046	2,146	1925	4,962	(3)	11,748	1,944
1921	1,956	(3)	2,471	1,060	1926	5,394	4,592	(3)	11,925
1922	2,281	2,022	7,349	2,249	1927	5,969	3,708	13,395	871
1923	6,362	3,301	6,761	379	1928	7,626	5,224	(3)	21,119

[1] Figures cover chemicals, as follows—1919: Binoxide, nitrate, and sulphide; 1920: Binoxide, hydroxide, nitrate, and sulphide; 1921 and 1925: Chloride, hydroxide, and sulphide; 1922: Binoxide, hydroxide, sulphide, and sulphydrate; 1923–24: Hydroxide and sulphide; 1926: Hydroxide, sulphate, and sulphide; 1927: Binoxide, hydroxide, and sulphide; 1928: Binoxide, hydroxide, sulphate, and sulphide.

[2] Figures cover production, not sales.

[3] Included under "Other barium chemicals."

IMPORTS AND EXPORTS

Imports of lithopone, barium binoxide, blanc fixe, natural and precipitated barium carbonate, and barium nitrate in 1928 showed increases over 1927. Following are the compounds imported and their increases or decreases: Ground barite, decrease of 5 per cent in quantity and 13 per cent in total value; lithopone, increase of 24 per cent in quantity and 23 per cent in value; barium binoxide, increase of 9 per cent in quantity and 4 per cent in value; blanc fixe, increase of 53 per cent in quantity and 58 per cent in value; precipitated barium carbonate, increase of 6 per cent in quantity and decrease of 2 per cent in value; natural barium carbonate (witherite), increase of 31 per cent in quantity and 25 per cent in value; barium chloride, decrease of 26 per cent in quantity and 44 per cent in value; barium nitrate, increase of 11 per cent in quantity and 6 per cent in value; and barium hydroxide, decrease of 16 per cent in quantity and 19 per cent in value.

Exports of lithopone increased from 2,110 short tons, valued at $222,585, in 1927 to 3,326 tons, valued at $337,565, in 1928. The average value per ton, however, fell from $105.49 in 1927 to $101.49 in 1928.

Barium compounds imported for consumption in the United States, 1921–1928

[Value at port of shipment]

Year	Ground barite		Lithopone		Barium binoxide		Blanc fixe (precipitated barium sulphate)		Artificial barium carbonate (chemically precipitated)	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1921	1,002	$16,942	5,247	$432,019	669	$127,631	769	$22,470	2,238	$80,603
1922	4,696	59,453	10,763	885,671	1,009	189,334	2,187	76,445	5,212	210,250
1923	6,022	88,741	10,440	776,383	905	152,270	587	32,063	1,901	79,482
1924	2,830	38,292	6,830	543,025	860	120,374	1,047	50,465	3,752	128,217
1925	3,203	40,008	6,330	478,395	635	70,553	1,996	81,439	7,188	160,164
1926	3,347	44,781	8,686	661,700	49	8,157	2,973	136,697	9,224	189,167
1927	3,259	38,568	7,979	656,166	6	1,264	2,400	107,179	4,918	119,014
1928	3,098	33,378	9,885	808,200	6	1,310	3,680	168,923	5,222	116,241

Barium compounds imported for consumption in the United States, 1921–1928—Con.

Year	Natural barium carbonate (ground witherite)		Barium chloride		Barium nitrate		Barium hydroxide	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1921	668	$25,188	2,186	$72,621	(1)	(1)	(1)	(1)
1922	1,472	39,114	1,962	112,785	[2] 179	[2] $16,795	[2] 73	[2] $6,573
1923	1,557	41,823	1,278	75,014	511	59,766	181	16,872
1924	2,500	56,415	2,330	100,810	513	54,638	174	8,241
1925	2,390	63,634	2,167	67,306	703	58,192	120	5,605
1926	3,380	80,679	1,773	49,426	602	49,494	236	9,789
1927	3,300	65,821	1,577	45,285	711	65,284	222	12,439
1928	4,311	82,434	1,172	25,253	789	69,010	186	10,031

[1] Not separately recorded prior to the tariff of Sept. 22, 1922.
[2] Sept. 22 to Dec. 31.

Lithopone exported from the United States, 1922–1928[1]

Year	Short tons	Value		Year	Short tons	Value	
		Total	Average			Total	Average
1922	1,616	$169,982	$105.19	1926	1,941	$200,412	$103.25
1923	1,485	176,624	118.94	1927	2,110	222,585	105.49
1924	923	104,783	113.52	1928	3,326	337,565	101.49
1925	1,287	132,771	103.16				

[1] Not separately recorded prior to 1922.

PRICES

The accompanying table gives the range of quotations on barite and the barium products, 1926 to 1928. Quotations on crude barite are taken from the Engineering and Mining Journal and represent prices in Missouri. Quotations on ground barite are taken from the Oil, Paint, and Drug Reporter and represent prices at St. Louis; quotations on lithopone and barium chemicals are taken from the same source and represent prices at New York.

Range of quotations on barite and barium products, 1926–1928

	Unit	1926	1927	1928
Crude barite	Short ton	$8.00 –$8.50	$8.00	$6.50 –$7.50
Ground barite	do	23.00	23.00	23.00
Lithopone	Pound	.05⅞– .06⅝	.05⅞	.05¾– .05⅞
Barium carbonate	Short ton	50.00 –55.00	$48.00 –54.00	47.50 –60.00
Barium chlorate	Pound	.14 – .15	.14 – .15	.14 – .15
Barium chloride	Short ton	60.00 –66.00	52.00 –65.00	54.00 –70.00
Barium nitrate	Pound	.07½– .09	.07½– .10	.08¼– .08½
Barium sulphate (blanc fixe), dry	do	.04 – .04½	.04¼– .04⅜	.03⅝– .04½
Barium sulphate (blanc fixe), pulp	Short ton	53.00 –65.00	60.00 –65.00	40.00 –60.00

The following are the designations on which quotations in the preceding table are based.

Crude barite, "f. o. b. mines."
Ground barite, "domestic, including barrels, f. o. b. St. Louis."
Lithopone, "in barrels, l. c. l."
Barium carbonate, "bags, works."
Barium chlorate, "kegs."
Barium chloride, "crystals, bags."
Barium nitrate, "casks."
Barium sulphate (blanc fixe), "dry, in barrels, l. c. l."
Barium sulphate (blanc fixe), "pulp, works."

PRODUCERS

Producers of barium products in the United States active in 1928 are listed below, with the addresses of their main offices and the locations of their plants.

Ground barite:	
Chemical & Pigment Co. (Inc.), Oakland, Calif	Oakland, Calif.
Clinchfield Sand & Feldspar Co., Baltimore, Md	Kings Creek, S. C.
Commercial Minerals Co., San Francisco, Calif	San Francisco, Calif.
C. P. De Lore Co., St. Louis, Mo	Mississippi River and River Des Peres, St. Louis, Mo.
Flynt Silica & Spar Co., Los Angeles, Calif	Daggett, Calif.
National Pigments & Chemical Co., St. Louis, Mo	Adelbert and St. Louis, Mo.
Thompson, Weinman & Co., New York, N. Y	Cartersville, Ga.
Lithopone:	
Chemical & Pigment Co. (Inc.), Oakland, Calif	Oakland, Calif.
Do	Collinsville, Ill.
Do	St. Helena, Md.
E. I. du Pont de Nemours & Co., Wilmington, Del	Newark, N. J.
Do	Philadelphia, Pa.
Eagle-Picher Lead Co., Chicago, Ill	Argo, Ill.
Grasselli Chemical Co., Cleveland, Ohio	Grasselli, N. J.
Krebs Pigment & Chemical Co., Newport, Del	Newport, Del.
Mineral Point Zinc Co., care New Jersey Zinc Co., New York, N. Y.	Depue, Ill.
New Jersey Zinc Co. (of Pennsylvania), New York, N. Y.	Palmerton, Pa.
Sherwin-Williams Co., Cleveland, Ohio	Chicago, Ill.
United Color & Pigment Co., Newark, N. J	Newark, N. J.
Barium chemicals: [2]	
Alton Barium Products Co., Alton, Ill	Alton, Ill.
Barium Mining Corporation & Barium Reduction Corporation, Charleston, W. Va.	South Charleston, W. Va.
Barium Products (Inc.), Modesto, Calif	Modesto, Calif.
Chicago Copper & Chemical Co., Chicago, Ill	Blue Island, Ill.
E. I. du Pont de Nemours & Co., Wilmington, Del	Philadelphia, Pa.
Grasselli Chemical Co., Cleveland, Ohio	Grasselli, N. J.
Oakland Chemical Co., New York, N. Y	New York, N. Y.
Titanium Pigment Co. (Inc.), St. Louis, Mo	Carondelet Station, St. Louis, Mo.

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[2] Includes only those using barite.

ABRASIVE MATERIALS [1]

By OLIVER BOWLES [2]

INTRODUCTION

The innumerable machines that take so important a place in modern life require a great number of highly finished and accurately sized parts, in the manufacture of which grinding and polishing processes are of great importance. Furthermore, many processes of manufacture involve grinding and pulverizing. For example, wood must be ground to a pulp for the manufacture of paper, and various ores, minerals, and products of vegetable origin must be ground to fine powders to prepare them for use or for further treatment. Blocks of stone must be polished for monumental and other uses, and the surfaces of plate glass, steel, copper, wood, and other materials must likewise be smoothed and polished for many applications.

The extensive employment of grinding and polishing has created a demand for great quantities and a wide variety of abrasives or grinding media. Marked progress has been made not only in production and preparation of abrasives but also in their use. The unparalleled growth of the automobile industry has increased the demand for abrasives and has led to vast improvements in grinding machinery. It is claimed that one particular grinding operation in automobile manufacture that required five hours in 1904 could be performed with much greater accuracy and perfection in five minutes in 1928.

Abrasive materials fall into two distinct groups designated as natural abrasives and artificial abrasives. In the first group are such products as emery or garnet used in the manufacture of coated abrasive papers and sandstones used for making grindstones and pulpstones; in the second group are manufactured products such as carborundum and steel shot.

Natural abrasive production, to which special attention is given in this report, includes a number of widely scattered dissimilar enterprises engaged in placing various products on the market. According to present-day standards of mining and manufacture, few, if any, of these enterprises would be considered large. Nevertheless, individually as well as collectively, they are important elements in the industrial life of the country inasmuch as they supply not only the tools for grinding, polishing, and other abrasive operations but also the ingredients of cleansing compounds, without which the great wood, leather, glass, metal-working, and other industries, as well as many householders, would be put to great expense and inconvenience in the use of substitutes.

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[1] Work on manuscript completed November, 1929.

[2] Figures on production compiled by Miss A. T. Coons and Miss B. H. Stoddard, of the Bureau of Mines. Data on imports and exports compiled by J. A. Dorsey, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.

The commodities considered in this chapter are used alone for grinding, polishing, and cleansing or as essential constituents of manufactured products employed for abrasive purposes. Some of the minerals considered are also used in other ways—for example, tripoli as a filler and diatomite for thermal insulation. Production figures for these minerals that have been reported to the bureau are not sufficiently detailed to permit an allocation to abrasive and to other uses; therefore, the total production for all uses is shown in this report. Both feldspar and quartz are used as abrasives, but the quantity so used is relatively small and can not be determined with any degree of accuracy. Therefore, they are considered in other chapters of Mineral Resources, entitled "Feldspar" and "Silica."

Statistics on artificial abrasives are included for comparison and because of their strong influence on the marketing of natural abrasives.

NATURAL ABRASIVES

Under the head of natural abrasives in this report are included millstones and related quarry products, such as chasers, dragstones, and paving stone for chaser mills; grindstones and pulpstones; oilstones and other whetstones, hones, scythestones, and rubbing stones; corundum and emery; abrasive garnet; tripoli; diatomite (diatomaceous earth); pumice; and pebbles for grinding and lining for tube mills. These natural abrasives were produced in 1928 in 23 States, as follows:

Arizona	Pumice.
Arkansas	Oilstones.
California	Diatomite, grinding pebbles, and pumice.
Florida	Diatomite.
Illinois	Tripoli.
Indiana	Rubbing stones, scythestones, and whetstones.
Kansas	Pumice.
Minnesota	Grinding pebbles and tube-mill lining.
Missouri	Tripoli.
Nebraska	Pumice.
Nevada	Diatomite.
New Hampshire	Diatomite, garnet, millstones, and scythestones.
New York	Diatomite, emery, garnet, and millstones.
North Carolina	Millstones.
Ohio	Grindstones, pulpstones, rubbing stones, scythestones, and whetstones.
Oklahoma	Tripoli.
Oregon	Diatomite.
Pennsylvania	Rottenstone.
Tennessee	Tripoli.
Vermont	Scythestones.
Virginia	Emery and millstones.
Washington	Diatomite, pulpstones, and rubbing stones.
West Virginia	Grindstones and pulpstones.

MILLSTONES

The value of the millstones or burrstones and related quarry products—chasers, dragstones, and pavers—sold by producers in the United States in 1928 was $42,886, an increase of 21 per cent over

1927. During the past eight years Ulster County, N. Y., has been the principal source of output, and the largest number of producers reported from that region.

American millstones have been and are still for the most part made of quartz sandstone and conglomerate, chiefly in Ulster County, N. Y., and Montgomery County, Va. Millstones are also made of granite, particularly in Alabama, Maine, Minnesota, New Hampshire, and North Carolina. The production recorded in Mineral Resources includes only the stones made for other than purely local use. Doubtless a large number of stones have been made in many unrecorded localities as local use has required, and they have been made of other rocks than those specified, particularly in the mountain sections of the Southern States. Formerly the millstone manufacturing industry was much larger than at present. About 1880 the total value of the stones produced and sold in the United States was around $200,000 annually. The production has declined since the late eighties and during the last eight years has been less than $50,000 worth of stones annually. The decline is due in part to the fact that the manufacture of millstones is a handcraft in which, as in many others in the United States, the old master craftsmen, who are gradually disappearing, are not being replaced. In part, also, the change is due to new processes in the grain, paint, and mineral milling industries in which the old-style burrstones and chaser mills are being supplanted by grinding equipment of an entirely different type.

Value of millstones, chasers, and dragstones sold by producers in the United States, 1919–1928

Year	New York		Other States [1]		Total	
	Producers	Value	Producers	Value	Producers	Value
1919	7	$10,155	11	$56,817	18	$66,972
1920	8	13,331	11	49,994	19	63,325
1921	12	14,672	7	9,852	19	24,524
1922	12	17,025	4	3,828	16	20,853
1923	17	14,344	4	7,885	21	22,229
1924	17	18,215	5	11,910	22	30,125
1925	13	14,063	5	8,427	18	22,490
1926	12	23,629	7	22,308	19	45,937
1927	12	26,015	5	9,423	17	35,438
1928	14	26,224	6	16,662	20	42,886

[1] 1919: Alabama, North Carolina, Pennsylvania, and Virginia; 1920: Alabama, Maryland, North Carolina, and Virginia; 1921: Alabama, New Hampshire, North Carolina, and Virginia; 1922: Alabama, North Carolina, and Virginia; 1923: Maine, Minnesota, North Carolina, and Virginia: 1924–1928: New Hampshire, North Carolina, and Virginia.

GRINDSTONES AND PULPSTONES

Grindstones and pulpstones are made from sandstone quarried in northeastern Ohio, western West Virginia, eastern Michigan, and in Pierce County, Wash. There was no production in Michigan in 1928. The total output of such stones in the United States in 1928 was 33,238 short tons, valued at $1,508,837, an increase of 4 per cent in quantity and a decrease of 3 per cent in value compared with 1927. As may be noted from the following table, which shows the production over a period of years, the tonnage of grindstones produced has gradually declined, undoubtedly because of the substitution of manufactured abrasive wheels for the natural stones.

Grindstones and pulpstones sold by producers in the United States, 1919–1928

Year	Grindstones		Pulpstones		
	Short tons	Value	Pieces	Short tons	Value
1919	40,755	$993,959	2,450	6,110	$342,056
1920	44,832	1,239,990	2,321	8,652	467,014
1921	16,310	477,259	2,941	10,030	750,063
1922	21,367	574,900	[1] 1,619	[1] 5,157	[1] 445,286
1923	37,384	1,008,899	2,533	9,186	680,416
1924	28,991	852,260	2,660	9,193	814,409
1925	28,970	864,637	2,530	8,370	841,302
1926	28,669	875,240	2,804	9,670	997,994
1927	23,222	633,207	2,707	8,709	921,543
1928	24,222	606,408	2,461	9,016	902,429

[1] Exclusive of sales in Washington prior to 1923.

The companies producing grindstones and pulpstones in the United States in 1928, with the locations of the deposits from which the stone was obtained, were as follows:

OHIO

Cuyahoga County: Berea—The Cleveland Stone Co. (address, Cleveland); grindstones, lathe stones.
Holmes County:
  Glenmont—The Briar Hill Stone Co.; grindstones.
  Killbuck—Mount Pisbia Stone Co. (address, Elgin); grindstones.
Jefferson County:
  Empire—Smallwood Stone Co. (address, Steubenville); pulpstones.
  Hammondsville—The International Pulpstone Co. (address, Elyria); pulpstones.
Lorain County:
  Amherst—
    The Cleveland Stone Co. (address, Cleveland); grindstones.
    The Ohio Quarries Co. (address, Cleveland); grindstones.
  Columbia Station—Columbia Stone Co.; grindstones.
  Kipton—The Nicholl Stone Co. (address, Lorain); grindstones.
Washington County:
  Brokaw (near), Hayward, Henry—The Cleveland Stone Co. (address, Cleveland); grindstones.
  Constitution—The Constitution Stone Co.; grindstones.
  Marietta—
    The Eureka Stone Co.; grindstones.
    The Hall Grindstone Co.; grindstones.
    Ohio Valley Stone Co.; grindstones.

WASHINGTON

Pierce County: Wilkeson—Walker Cut Stone Co. (address, Tacoma); pulpstones.

WEST VIRGINIA

Boone County: Jeffery—The International Pulpstone Co. (address, Elyria, Ohio); pulpstones.
Jackson County: Sherman—The Eureka Stone Co. (address, Marietta, Ohio); grindstones.
Monongalia County:
  Fairmont (near)—The Smallwood-Low Stone Co. (address, Fairmont); pulpstones.
  Little Falls—The West Virginia Pulpstone Corporation (address, Cleveland, Ohio); pulpstones.
  Opekiska—
    The Richard L. Cawood Co. (address, East Liverpool, Ohio); pulpstones.
    The General Stone Co. (address, Amherst, Ohio); pulpstones.
    Smallwood Stone Co. (address, Steubenville, Ohio); pulpstones.
  Uffington—Uffington Stone Co.; pulpstones.

Wetzel County:
- Hundred—C. & M. Quarries Co. (address, Marietta, Ohio); pulpstones.
- Littleton—
  - American Stone Co.; pulpstones.
  - Southern Stone Co.; pulpstones. (Idle in 1928.)

OILSTONES AND OTHER WHETSTONES, SCYTHESTONES, RUBBING STONES, ETC.

Natural stone or quarry products used as abrasive material include, besides the millstones, grindstones, and pulpstones above considered, oilstones and other whetstones, hones, rubbing stones, and scythestones. These are cut or otherwise shaped, usually in small pieces, in a great variety of forms for the special uses indicated by their names. Oilstones are produced in the United States from novaculite quarried in Arkansas; other whetstones chiefly from sandstone quarried in Indiana and Ohio; scythestones from sandstone quarried in Indiana and Ohio and from schist quarried in New Hampshire and Vermont; and rubbing stones from sandstone quarried in Indiana, Ohio, and Washington.

Oilstones and other whetstones, hones, scythestones, and rubbing stones sold by producers in the United States, 1919–1928

Year	Short tons	Value	Year	Short tons	Value
1919	1,463	$235,943	1924	1,056	$258,943
1920	1,144	231,747	1925	970	272,224
1921	831	173,025	1926	1,680	223,359
1922	1,016	197,450	1927	1,048	233,545
1923	1,223	231,812	1928	956	228,245

The manufacturers of oilstones and other whetstones, scythestones, and rubbing stones from natural stone in 1928 and the sources of their raw materials were as follows:

The American Rubbing Stone Co., Cincinnati, Ohio: Whetstones and rubbing stones; manufactured from sandstone quarried at Floyds Knobs, Floyd County, Ind.

The Bracher Co., Belleville, N. J.: Oilstones; manufactured from novaculite obtained from quarries near Hot Springs, Garland County, Ark.

J. A. Chaillaux, West Baden, Ind.: Scythestones; manufactured from sandstone quarried at West Baden, Orange County, Ind., and McDermott, Scioto County, Ohio. Stone also sold to other companies for the manufacture of whetstones.

The Cleveland Stone Co., Cleveland, Ohio: Scythestones and holystones; manufactured from stone obtained at Berea, Cuyahoga County, and Amherst, Lorain County, Ohio.

Garland Whetstone & Realty Co., Hot Springs, Ark.: Produces rough stone, in Garland County, for oilstones, some of which is shipped abroad and some sold to manufacturers in this country.

The Ohio Quarries Co., Cleveland, Ohio: Rubbing stones; manufactured from sandstone quarried at Amherst, Lorain County, Ohio.

Pike Manufacturing Co., Pike, N. H.:
- Oilstones; manufactured from novaculite obtained from quarries near Hot Springs, Garland County, Ark.
- Whetstones; manufactured from sandstone obtained from quarries near West Baden, Orange County, Ind., and Amherst, Lorain County, and McDermott, Scioto County, Ohio.
- Scythestones; manufactured from schist quarried at Pike, Grafton County, N. H., and Brownington, Orleans County, Vt.

Tenino Stone Co. (Inc.), Tenino, Wash.: Holystones; manufactured from sandstone quarried at Tenino, Thurston County, Wash.

CORUNDUM AND EMERY

Corundum, the natural aluminum oxide (Al_2O_3), is a mineral exceeded only by the diamond in hardness. In the past it has been used extensively as an abrasive, but no production in the United States has been reported since that in 1918. It has been supplanted almost entirely by the artificial aluminum oxide abrasives.

The best varieties of emery consist of 50 to 60 per cent corundum and 40 to 50 per cent magnetite; other varieties contain varying amounts of spinel, hematite, and other minerals. The corundum is the important abrading agent. Emery is used principally in the metal trades, where, however, it is being replaced by artificial abrasives to a great extent. It was produced for sale in 1928 from the Peekskill region, New York, and from deposits in Pittsylvania County, Va. Deposits in other localities have either been exhausted or under present conditions can not meet the competition of emery from present domestic sources or from Greece and Turkey, both of which are important foreign sources of supply.

The emery industry of Turkey was greatly depressed in 1928, the total production being about 10,000 metric tons compared with 20,000 to 30,000 tons annually before the war. Exports to the United States which amounted to 6,789 metric tons in 1924 dropped to 2,931 tons in 1927 and to 2,841 tons in 1928. The best foreign emery is obtained from the Greek island Naxos.

Emery sold or used by producers in the United States, 1919–1928

Year	Short tons	Value	Year	Short tons	Value
1919	2,601	$23,203	1924	2,195	$19,756
1920	2,327	21,685	1925	769	5,907
1921	305	2,250	1926	386	3,641
1922	1,468	17,511	1927	506	5,855
1923	2,286	29,478	1928	1,341	16,787

The companies producing emery in the United States in 1928, with the locations of the deposits from which the emery was obtained, were as follows:

NEW YORK

Westchester County:
  Peekskill (near)—
    Blue Corundum Mining Co. (address, Easton, Pa.).
    Keystone Emery Mills (address, 4329 Paul Street, Frankford, Philadelphia, Pa.).
    Smith & Ellis (address, Peekskill).

VIRGINIA

Pittsylvania County: Chatham—Niagara Emery Mills (Inc.) (address, 4329 Paul Street, Frankford, Philadelphia, Pa.).

GARNET

Garnet is a complex silicate mineral or, more properly, a group of minerals varying somewhat in composition and properties. The iron-aluminum garnet, almandite, is the one most commonly used as an abrasive. Garnet is somewhat harder than quartz, and the nature of its fracture is such that the broken particles have enough flat surfaces to permit firm attachment to a paper backing and at the same time expose very efficient cutting edges. About 90 per cent of the garnet mined is used for the manufacture of abrasive papers and cloths which have a higher cutting efficiency than sandpaper. Powdered garnet is used for grinding purposes, particularly for the grinding of plate glass.

The chief production of garnet in the United States is from Warren County, N. Y. Merrimack County, N. H., has been second in importance in recent years. The garnet of the former locality occurs as crystals scattered throughout a granite gneiss and constitutes 4 to 8 per cent of the rock. The rock is quarried by open-pit methods, passed through crushers and rolls, and the garnet separated from the waste rock by jigs and tables.

In 1928 the sales of abrasive garnet by producers in the United States amounted to 6,617 short tons, valued at $459,307. The average value of garnet mined in 1928 was $69 a ton, as compared with $83 in 1927, $82 in 1926, and $85 in 1925. The marked decrease in average value for 1928 does not indicate a general downward trend in prices but was occasioned by an exceptionally low return realized from the sales of one company.

Abrasive garnet sold or used by producers in the United States, 1919–1928

Year	Short tons	Value	Year	Short tons	Value
1919	4,944	$310,131	1924	8,290	$674,176
1920	5,476	434,425	1925	8,429	712,853
1921	3,048	260,687	1926	6,397	523,875
1922	7,054	566,879	1927	6,939	573,525
1923	9,006	688,437	1928	6,617	459,307

The companies producing garnet in the United States in 1928, with the locations of the deposits from which the garnet was obtained, were as follows:

NEW HAMPSHIRE

Merrimack County:
  Danbury—Ford Motor Co. (address, Detroit, Mich.).
  South Danbury—Wausau Abrasives Co. (address, Wausau, Wis.).

NEW YORK

Hamilton County: Indian Lake—Adirondack Garnet Products (Inc.) (address, North River).
Warren County:
  North Creek—
    Barton Mines Corporation.
    North River Garnet Co.
  Riparius—Warren County Garnet Mills (address, 149 Orange Street, Newark, N. J.).

TRIPOLI

Tripoli is an extremely fine-grained porous form of silica of the chalcedony variety. Some authorities believe that it was formed by decomposition of siliceous limestones, but others question this mode of origin. Most of the tripoli mined is applied to uses other than abrasive. Its most important abrasive use is as a constituent of buffing compounds. It is also used in metal pastes and polishes and in rubs and polishes for paint and lacquer finishes. It is a constituent of various scrubbing and scouring powders and soaps and is said to have superior qualities for cleaning tile floors, woodwork, and kitchen appliances.

Rottenstone is a material related to tripoli but is somewhat more earthy and less siliceous. It is usually regarded as residual matter from the natural decomposition of argillaceous rocks or of impure limestone. It is produced in Lycoming County, Pa., and it is imported from Europe. In Europe it is mined in Derbyshire (England), in Wales, and in Belgium and is used more extensively there than in America. In England it is used as one of the abrasive bases in pastes and liquid metal polishes. In America it is used as a mild abrasive in wood and metal finishing, as, for example, in the scouring of metal surfaces prior to plating.

The value of tripoli sold (including Pennsylvania "rottenstone") in 1928, as reported by producers, was $555,576. This value corresponds approximately to 34,000 short tons of material, of which about one-sixth was sold in the form of crude quarry products. Most of the production, however, was sold in ground or otherwise prepared form by the producers at values ranging from $13 to $24 a ton.

The chief sources of production in 1928, as in previous years, were a small area lying in Newton County, Mo., and Ottawa County, Okla., and the Alexander-Union County area in southern Illinois; an appreciable output was also reported from Tennessee. The output of rottenstone in Lycoming County, Pa., is also included in the figures here presented.

Some of the Missouri-Oklahoma tripoli is produced primarily for use as an abrasive, and some of it is mined to be worked up into filter blocks, the cuttings and waste from the making of which are ground and prepared for abrasive and other uses. The larger part of the Missouri output is used as filler, for foundry facings, and in many other ways. The Illinois product is generally known simply as "silica," and although used to some extent as an abrasive for metal polishes, in soaps, and in cleansers, it is very largely used in paint and fillers, in making glass, in the body and enamel of ceramic wares, and for facing foundry molds.

It is not possible to determine the amounts of tripoli used as abrasive material and otherwise nor to obtain from the producers uniform reports on the quantity and value of the crude or rough quarried material, as they sell much of the product originally in some manufactured or prepared form. Statistics herein reported and in earlier chapters of Mineral Resources therefore do not permit satisfactory comparison between years or between producing States. In the following table the value for the total output of crude tripoli is in part an arbitrarily assigned value, inasmuch as a large part of the output is not sold crude but in ground or other prepared form by the original producers. The values given "as sold" are the total realizations as reported by producers and include receipts from sales of both crude and ground or otherwise finished material.

Tripoli (including Pennsylvania "rottenstone") sold or used by producers in the United States, 1919–1928

Year	Illinois			Other States [1]			Total		
	Short tons	Value		Short tons	Value		Short tons	Value	
		Crude (estimated)	As sold (crude and finished)		Crude (estimated)	As sold (crude and finished)		Crude (estimated)	As sold (crude and finished)
1919	13, 014	$32, 961	$116, 492	11, 278	$65, 049	$65, 049	24, 292	$98, 010	$181, 541
1920	24, 458	66, 509	360, 651	15, 775	97, 567	209, 026	40, 233	164, 076	569, 677
1921	7, 765	27, 333	125, 352	4, 575	26, 559	87, 661	12, 340	53, 892	213, 013
1922	18, 747	54, 741	194, 371	11, 458	50, 568	122, 357	30, 205	105, 309	316, 728
1923	11, 522	31, 230	117, 201	15, 560	30, 960	265, 556	27, 082	62, 190	382, 757
1924	13, 466	23, 566	116, 188	15, 010	31, 971	273, 221	28, 476	55, 537	389, 409
1925	11, 809	27, 480	143, 859	17, 579	31, 290	291, 027	29, 388	58, 770	434, 886
1926	11, 948	29, 870	192, 483	19, 421	35, 152	331, 126	31, 369	65, 022	523, 609
1927	(2)	(2)	(2)	(2)	(2)	(2)	26, 099	66, 452	447, 068
1928	(2)	(2)	(2)	(2)	(2)	(2)	34, 043	73, 689	555, 576

[1] 1919–1923: Missouri, Oklahoma, and Pennsylvania; 1924–1928: Missouri, Oklahoma, Pennsylvania, and Tennessee.

[2] Bureau of Mines not at liberty to publish figures.

The companies producing tripoli (including Pennsylvania "rottenstone") in the United States in 1928, with the locations of the deposits from which the material was obtained, were as follows:

ILLINOIS

Alexander County:
Elco and Tamms—Illinois Silica Co. (address, Cairo).
Tamms (near)—Star Silica Co. (address, Cairo).

MISSOURI

Cape Girardeau County: Cape Girardeau—Cape Silica Co.
Jasper County: Carthage—Independent Gravel Co. (address, Frisco Building, Joplin).
Newton County: Racine—Independent Gravel Co. (address, Frisco Building, Joplin).

OKLAHOMA

Ottawa County: Seneca, Mo. (near)—American Tripoli Co. (address, Seneca, Mo.).

PENNSYLVANIA

Lycoming County: Antes Fort—Penn Keystone Co. (address, 551 Fifth Avenue, New York, N. Y.).

TENNESSEE

Bradley County: Cleveland (near)—Southern Minerals Corporation (address, 192 Bank Street, Burlington, Vt.).

DIATOMITE

Diatomite is also known as diatomaceous earth, infusorial earth, and kieselguhr. It is a fine-grained hydrous or opaline form of silica. Deposits of diatomite consist chiefly of accumulations of the skeletal remains of minute marine organisms known as diatoms. The organic structure of the particles is plainly visible under a microscope with high magnification, affording a definite and easy means of identification. Thus, diatomite can be readily distinguished from tripoli, which shows no organic structure.

The outstanding characteristics of diatomite, upon which its usefulness depends, are its extreme fineness and uniformity of grain size, its light weight, and its high porosity. When dry it weighs only 18 to 20 pounds per cubic foot, and exceptionally even less, and it will absorb from one and a half to two times its weight of water.

The chief use of diatomite is not as an abrasive; it is used mainly as a filtering and clarifying agent, as an insulator, as a filler, and as an absorbent. As an abrasive its chief uses are for polishing metals, glass, furniture, enamel, finger nails, and teeth. Its value as a polishing agent depends not only upon the hardness, fineness, and uniformity of the grain size of the siliceous particles but upon its porous structure and low compressive strength, which permit it to crumble under pressure and thus provide an abrasive effect without scratching. It is a good cleanser not only because of its abrasive qualities but also because of its power to absorb readily grease, coloring matter, and other impurities.

In 1928, as usual, the chief source of production of diatomite was California; sales were also reported from Oregon, Washington, Nevada, Florida, New York, and New Hampshire.

Diatomite sold or used by producers in the United States, 1919–1928

Year	Short tons	Value	Year	Short tons	Value
1919	42, 642	$531, 960	1924	63, 163	$693, 917
1920	61, 922	1, 079, 693	1925	73, 030	922, 281
1921	[1] 55, 134	[1] 682, 616	1926	[1] 87, 126	[1] 1, 081, 564
1922	44, 761	386, 669	1927	(2)	(2)
1923	65, 833	699, 406	1928	(2)	(2)

[1] Partly estimated.
[2] Bureau of Mines not at liberty to publish figures.

The companies producing diatomite in the United States in 1928, with the locations of the deposits from which the diatomite was obtained, were as follows:

CALIFORNIA

Los Angeles County: Covina—The Feather-Stone Co. (address, 911 Mateo Street, Los Angeles).
Monterey County:
    Bradley (near)—
        California Kieselguhr Co. (address, San Miguel).
        Pacatome Co. (address, 814 Kohl Building, San Francisco).
    Monterey (near)—The Calatom Co. (address, Monterey).
Santa Barbara County:
    Lompoc—
        Celite Corporation.
        National Silica Products Co. (address, 605 Market Street, San Francisco).

FLORIDA

Lake County: Clermont—Florida Diatomite Co.

NEVADA

Elko County: Carlin—Tri-o-lite Products Co.
Esmeralda County: Mount Montgomery (near)—U. S. Diatom Corporation (address, 800 Santa Fe Avenue, Los Angeles, Calif.).
Storey County: Virginia City—Electro-Silicon Co. (address, 22 Cliff Street, New York, N. Y.).

NEW HAMPSHIRE

Grafton County: Canaan—New England Minerals (Inc.).

NEW YORK

Herkimer County: Poland—Adirondack Diatomaceous Earth Co. (address, Herkimer).

OREGON

Deschutes County: Terrebonne—Atomite Corporation (address, 1021 Pacific Building, Portland).

WASHINGTON

Grant County: Quincy—E. J. Webley.
Kittitas County: Kittitas—Kittitas Diatomite Co. (address, Ellensburg).
Yakima County: Yakima—Washington Silica & Fire Clay Co. (address, 3205 Hewitt Avenue, Everett).

PUMICE AND PUMICITE

Pumice is an extremely porous glassy lava which has been forced from volcanoes by the sudden expansion of gases inclosed in the molten magma. It is usually found near volcanoes in solid coherent blocks which are generally white or light gray in color. When dry the blocks are so porous that they will float on water. Lump pumice is used for polishing various metals; for rubbing down wood surfaces in the manufacture of furniture, pianos, phonographs, radios, and automobile bodies; and for cleaning and polishing stone and glass. Fine lump pumice is used as a toilet article. Ground pumice is used in cleaning, scouring, and polishing compounds, in tooth pastes and powders, and as an abrasive in rubber erasers.

Pumicite, also known as volcanic dust or volcanic ash, consists of small, sharp, angular grains of volcanic glass. It is used in making cleansing compounds, abrasive hand soaps, and metal polishes. Usually it is less uniform in grain size than diatomite and therefore finds more limited use as a fine polishing powder.

Production of pumice and pumicite in the United States in 1928 was reported from Yuma County, Ariz.; from Imperial and Inyo Counties, Calif.; from Comanche, Grant, Meade, Norton, and Sheridan Counties, Kans.; and from Custer and Lincoln Counties, Nebr. In California the output was largely lump pumice. In Kansas and Nebraska the pumice was dug from beds of fragmental volcanic glass or so-called ash. The total quantity sold or used by producers in 1928 was 57,430 short tons, valued at $278,516.

Pumice and pumicite sold or used by producers in the United States, 1919–1928

Year	Short tons	Value	Year	Short tons	Value
1919	36,051	$116,835	1924	43,651	$190,253
1920	41,838	114,433	1925	40,380	179,020
1921	37,108	158,540	1926	53,887	208,504
1922	45,262	175,600	1927	53,298	221.481
1923	56,575	214,169	1928	57,430	278,516

The companies producing pumice and pumicite in the United States in 1928, with the locations of the deposits from which the pumice and pumicite were obtained, were as follows:

ARIZONA

Yuma County: Bouse—Yuma Products Manufacturing Co. (address, 3648 Humboldt Street, Denver, Colo.).

CALIFORNIA

Imperial County:
  Calipatria (near)—A. W. Brand (address, 305 St. Louis Block, Pasadena).
  Estelle—Flynt Silica & Spar Co. (address, 1047 Richmond Street, Los Angeles).
Inyo County:
  Laws (near)—California Quarries Corporation (address, 1300 Quinby Building, Los Angeles).
  Shoshone—
    Fairbanks & Brown.
    Pacific Coast Borax Co. (address, Wilmington).

KANSAS

Comanche County: Wilmore—The Pumicite Co. (address, Ambassador Building, St. Louis, Mo.).
Grant County: Satanta (near)—Western Spar Products Co. (address, Dodge City).
Meade County:
  Fowler—
    Cudahy Packing Co. (address, 111 West Monroe Street, Chicago. Ill.).
    Robert Ingram.
  Meade—The Pumicite Co. (address, Ambassador Building, St. Louis, Mo.).
Norton County: Calvert—Davidson Pumice Co. (address, Norton).
Sheridan County: Hoxie—The Pumicite Co. (address, Ambassador Building, St. Louis, Mo.).

NEBRASKA

Custer County: Kingston—La Rue-Axtell Pumice Co. (address, Ingham).
Lincoln County: Ingham—La Rue-Axtell Pumice Co.

PEBBLES FOR GRINDING AND FLINT LINING FOR TUBE MILLS

The commercial production of pebbles used for grinding minerals, ores, cement, and for other purposes, together with the output of quartzite blocks for use as tube-mill liners, includes, so far as known to the Bureau of Mines, only the output of beach pebbles in southern California and of cut cubes and cut liners made of quartzite in Minnesota. The figures in the following table appear to cover the entire commercial output, but doubtless there was unrecorded additional production for local or own use by other companies than those reporting.

Pebbles for grinding and flint lining for tube mills sold or used by producers in the United States, 1919–1928

Year	Short tons	Value	Year	Short tons	Value
1919	9, 448	$85, 302	1924	2, 532	$37, 429
1920	10, 924	77, 823	1925	3, 831	50, 147
1921	989	14, 637	1926	6, 219	85, 146
1922	3, 159	30, 798	1927	3, 342	46, 856
1923	4, 551	51, 795	1928	6, 288	89, 321

ABRASIVE DIAMONDS

Abrasive diamonds, or industrial diamonds as they are commonly called, are of two types—the black diamond, or carbonado, and bort. The black diamond is the hardest known substance, the claim being made that it is 3 per cent harder than the gem diamond. It is lacking in cleavage, is opaque, and resembles a piece of lava or coal. Black diamonds are found chiefly and almost exclusively in the State of Bahia in the interior of Brazil. The second variety, or bort, consists of cull stones from the gem-diamond industry. Most of them are obtained from South Africa. Unlike the black diamond, bort has a distinct cleavage. Although the diamond is extremely hard it is also brittle and is easily shattered if subjected to a sudden shock or blow.

The chief use of industrial diamonds is in the manufacture of drill bits for rock drilling and boring. The diamonds are set in the lower edge of a hollow cylinder of soft annealed steel. By rotation the bit cuts out a cylindrical core of rock. Black diamonds are used chiefly for this purpose. The chief use of bort is in the manufacture of tools for truing abrasive wheels and in the manufacture of cutting tools which are used for turning hard rubber, ebonite, vulcanite, fiber, metals and alloys, mica, and other materials that dull other tools quickly. Diamond tools are of special value for the production of a large number of pieces of exact and uniform sizes. Perforated diamonds are used as dies for drawing fine wire of accurate and uniform cross section. Diamond saws up to 10 feet in diameter are used widely for sawing rock such as marble or granite. The diamonds are mounted in detachable steel sockets inserted at regular intervals around the rim. Small diamonds are used extensively as glass cutters. Fragments of bort are pulverized to form diamond dust which is used for cutting and polishing precious stones, as an abrasive in drilling diamonds to make diamond dies, and in sawing porcelain and similar hard materials.

No abrasive diamonds are produced in the United States. Import figures for the past five years, as given in the table on page 250, show a decrease in value of bort and dust, materials which are used chiefly for grinding and polishing, but a marked increase in the value of uncut diamonds used by glaziers, engravers, and miners. Imports of such diamonds in 1928 reached more than $2,750,000. Much progress has been made in the manufacture of synthetic abrasive products which are substituted for diamonds in some fields of application. The fact that diamond importations can steadily increase even when faced with the growing competition of synthetic abrasives is an indication of the rapidly increasing use of abrasive materials in industry.

MISCELLANEOUS ABRASIVE MATERIALS

River silt is used to a limited extent in cleansing powders and in the manufacture of bath bricks. Clays are used as mild abrasives in some polishes and cleaning soaps. Highly-burned clays are sometimes ground to a dust and used in metal polish. Talc is used for polishing peanuts and rice. Very pure high-grade lime is used for polishing surgical instruments and cutlery. Chalk is used as a mild abrasive for polishing plated ware. Feldspar is used in some window-cleaning compounds; as it is softer than quartz it is less liable to scratch glass than compounds containing some form of free silica. Silica sand is used widely not only in the stone-working industries for grinding smooth surfaces on slabs of slate, marble, and other materials, but also in various processes of sawing rock and other hard products. The abrading action of sand when driven forcibly with compressed air is utilized in sand-blast processes of cleaning stone buildings and castings in foundries, in cutting inscriptions on monuments, and in wood carving.

IMPORTS AND EXPORTS

Value of abrasive materials imported for consumption in the United States, 1924–1928

Material	1924	1925	1926	1927	1928
Millstones and burrstones	$6,311	$8,413	$6,266	$12,726	$6,354
Grindstones	122,440	124,319	120,335	134,804	114,874
Hones, oilstones, and whetstones	43,579	49,108	63,152	67,368	45,303
Emery and corundum	364,755	313,718	616,700	264,613	272,533
Garnet	54,402	200	--------	--------	115
Diatomaceous earth, tripoli, and rottenstone	9,504	6,589	14,544	15,403	21,883
Pumice	111,284	130,460	129,449	124,074	159,430
Diamond:					
Dust and bort	259,482	760,476	271,382	62,045	31,222
Glaziers' and engravers', unset, and miners'	1,116,862	1,976,640	1,939,735	2,148,275	2,756,895
Flint, flints, and flint stones, unground	114,958	105,041	120,078	93,658	144,313

Abrasive materials imported for consumption in the United States, 1927–28, by kinds

Kind	1927		1928	
	Quantity	Value	Quantity	Value
Millstones and burrstones:				
Rough or unmanufactured short tons	161	$11,631	104	$6,270
Bound up into millstones do	22	1,095	2	84
Grindstones, finished or unfinished do	2,001	134,804	1,773	114,874
Hones, oilstones, and whetstones do	584	67,368	196	45,303
Emery:				
Ore do	4,612	71,233	5,428	84,288
Grains, ground, pulverized, or refined pounds	(1)	(1)	(1)	(1)
Paper and cloth of emery or corundum do	(2)	52,147	(2)	41,817
Wheels, files, and other manufactures of which emery or corundum is the material of chief value pounds	94,999	51,600	100,962	51,148
Corundum (see also "Emery"):				
Ore short tons	1,269	70,038	1,568	82,867
Grains, ground, pulverized, or refined pounds	[1] 230,694	[1] 19,595	[1] 339,236	[1] 12,413
Garnet short tons	--------	--------	2	115
Diatomaceous earth, tripoli, and rottenstone do	1,338	15,403	2,607	21,883
Pumice:				
Crude or unmanufactured do	8,929	90,374	11,099	113,453
Manufactures of, or of which pumice is the component material of chief value short tons	(3)	33,700	(3)	45,977
Diamond:				
Bort carats	1,747	33,786	996	17,949
Dust pounds	(3)	28,259	(3)	13,273
Glaziers' and engravers', unset, and miners' carats	34,526	2,148,275	38,342	2,756,895
Flint, flints, and flint stones, unground short tons	15,191	93,658	15,719	144,313
	--------	2,922,966	--------	3,552,922

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[1] Emery included with corundum; not separately classified.
[2] 13,956 reams in 1927 and 7,152 reams in 1928; weight not recorded.
[3] Quantity not recorded.

Value of domestic abrasive materials exported from the United States, 1924–1928

Material	1924	1925	1926	1927	1928
Grindstones	$481, 397	$553, 750	$629, 748	$578, 113	$560, 975
Abrasive wheels, emery, and other	521, 840	439, 904	248, 631	240, 027	254, 493
All other natural abrasives, hones, whetstones, etc.	173, 731	195, 915	323, 447	419, 088	453, 055

ARTIFICIAL ABRASIVES

Artificial abrasives fall chiefly into three main groups—(1) metallic abrasives such as crushed steel, steel shot, and steel wool; (2) silicon carbide abrasives such as carborundum, crystolon, and carbolon; (3) aluminum oxide abrasives such as alundum, aloxite, exolon, and lionite. The metallic abrasives are used chiefly in loose form as cutting agents in sawing or drilling rock and other hard materials. A very important use of the silicon carbide and the aluminum oxide abrasives is in the manufacture of bonded abrasive wheels. The abrasive grains graded into uniform sizes are bonded together into wheels of varying degrees of coarseness and hardness. A fusible clay is used as the bonding material in vitrified grinding wheels. Sodium silicate, shellac, and bakelite are also employed as bonding materials. Much progress has been made in recent years in the development of highly efficient abrasive wheels; they are being used more and more as substitutes for natural abrasive products such as emery wheels, grindstones, and pulpstones.

An artificial abrasive consisting of tin oxide or a mixture of tin oxide and oxalic acid has been termed "putty powder." It is used for polishing marble and granite. Rouge and crocus, both of which are forms of ferric oxide, are employed to produce a high luster—the former on precious metals and the latter on tin and cutlery. Chromium oxide, manganese dioxide, and magnesia have limited use as abrasives.

The table that follows gives the production of silicon carbide, aluminum oxide, and steel shot or crushed steel grains. These materials compete with the natural abrasives used as grains—for example, emery, corundum, and garnet. The figures represent the total output of crude materials or first product of the manufacturing plants, not all of which is used as abrasive material; in fact, a large but undetermined part of the silicon carbide and aluminum oxide output is not so used. The total output is shown here without separation of the products according to the uses to which they are put, because it is thought that the proportion used as abrasive material has not fluctuated so widely in recent years as to destroy the value of these figures for comparison with the statistics of natural abrasives.

Crude artificial abrasives sold, shipped, or used, from manufacturing plants in the United States and Canada, 1919–1928

Year	Silicon carbide		Aluminum oxide		Metallic abrasives		Total	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1919	28, 435	$3, 380, 151	19, 723	$3, 811, 498	2, 360	$274, 200	50, 518	$7, 465, 849
1920	6, 887	1, 309, 605	32, 891	5, 956, 639	2, 659	225, 920	42, 437	7, 492, 164
1921	2, 707	475, 336	7, 325	1, 318, 771	3, 167	202, 040	13, 199	1, 996, 147
1922	16, 233	2, 022, 613	31, 898	3, 246, 714	5, 804	421, 148	53, 935	5, 690, 475
1923	21, 149	2, 786, 929	51, 391	5, 378, 926	8, 229	612, 140	80, 769	8, 777, 995
1924	17, 792	2, 161, 498	33, 708	3, 482, 577	8, 597	569, 665	60, 097	6, 213, 740
1925	24, 112	2, 493, 756	53, 253	4, 714, 562	11, 165	780, 612	88, 530	7, 988, 930
1926	17, 026	1, 702, 037	43, 967	4, 106, 699	12, 610	942, 429	73, 603	6, 751, 165
1927	26, 289	2, 603, 571	50, 973	4, 516, 637	13, 364	839, 683	90, 626	7, 959, 891
1928	22, 162	2, 286, 518	59, 103	5, 640, 901	18, 466	904, 629	99, 731	8, 832, 048

PHOSPHATE ROCK

By Bertrand L. Johnson [1]

GENERAL CONDITIONS

In 1928 the phosphate rock industry of the United States faced a decidedly increased consumption of phosphate rock in the domestic market, a rapidly declining market abroad for Florida hard rock, and a lessened demand within the United States for the phosphate rock from the Western States field. To meet the increased domestic consumption a greater quantity of phosphate rock was mined and marketed in 1928 than in 1927 in the Florida land-pebble and Tennessee fields, while the lessened demand for western rock showed in the marked declines both in mined and marketed production in the Western States fields. The declining foreign demand for Florida hard rock resulted in a greatly decreased production of that type of rock. The total quantities of domestic rock, both mined and marketed, exceeded those of the previous year. The increased activity in mining operations resulted in a slight excess of mine output over sales, and consequent increase in stocks of phosphate rock in the hands of the producers at the end of the year.

The export situation was unfavorable. A slight decrease in quantity exported was accompanied by a greater decrease in the value of the exports. These declines were due to the big decreases both in quantity and value of the hard-rock exports. There was also a decrease in the total value of the land-pebble shipments, although the quantity exported increased slightly. Imports of phosphate rock increased markedly both in quantity and value.

DOMESTIC MINE PRODUCTION

The quantity of phosphate rock mined in the United States in 1928 was 3,523,230 long tons, an increase of 498,081 tons, or 16.5 per cent, over 1927. The greater part of this—362,118 long tons—was the result of increased production in Florida, where the quantity of phosphate rock mined in 1928 was 14 per cent greater than in 1927. There was an increase of 140,991 tons, or 33 per cent, in the Tennessee field. The Western States showed a decrease of 5,028 tons, or 10.3 per cent, from 1927 in the quantity of phosphate rock mined.

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[1] The statistics in this report on the domestic industry were prepared by B. H. Stoddard and the data on imports and exports were compiled from the records of the Bureau of Foreign and Domestic Commerce by J. A. Dorsey, both of the Bureau of Mines. The assistance of K. G. Warner, also of the Bureau of Mines, in the statistical work on this report is also acknowledged.

Phosphate rock mined in the United States, 1919–1928, by States, in long tons

Year	Florida	Kentucky	South Carolina	Tennessee	Western States	Total
1919	1, 254, 609	8, 912	49, 032	522, 061	16, 935	1, 851, 549
1920	3, 255, 720	13, 203	42, 709	614, 474	48, 895	3, 975, 001
1921	2, 088, 251	15, 622	------------	317, 340	4, 961	2, 426, 174
1922	2, 018, 809	12, 236	------------	288, 330	17, 481	2, 336, 856
1923	2, 421, 571	18, 409	------------	469, 011	34, 575	2, 943, 566
1924	2, 373, 530	3, 424	------------	427, 614	40, 735	2, 845, 303
1925	2, 672, 650	14, 309	2, 147	480, 763	83, 802	3, 253, 671
1926	3, 064, 441	6, 097	------------	475, 742	45, 742	3, 592, 022
1927	2, 543, 708	------------	------------	432, 610	48, 831	3, 025, 149
1928	2, 905, 826	------------	------------	573, 601	43, 803	3, 523, 230

SALES OF DOMESTIC PHOSPHATE ROCK

The quantity of phosphate rock sold or used by producers in the United States in 1928 was greater than in any other year except the boom year 1920. The total value also was greater than that of any previous year except 1920. The quantity sold or used amounted to 3,501,406 long tons, an increase of 330,707 tons, or 10 per cent, over 1927. The total value was $12,443,179, an increase of $1,189,827, or 11 per cent, as compared with 1927. The average selling value a ton for 1928 was $3.55, the same as for 1927. The quantity of phosphate rock mined in 1928 exceeded the quantity sold or used by producers in that year by 21,824 tons.

Phosphate rock sold or used by producers in the United States, 1919–1928

Year	Long tons	Value	Year	Long tons	Value
1919	2, 271, 983	$11, 591, 268	1924	2, 867, 789	$10, 252, 083
1920	4, 103, 982	25, 079, 572	1925	3, 481, 819	11, 545, 678
1921	2, 064, 025	12, 270, 070	1926	3, 209, 976	10, 893, 800
1922	2, 417, 883	10, 482, 846	1927	3, 170, 699	11, 253, 352
1923	3, 006, 706	11, 576, 049	1928	3, 501, 406	12, 443, 179

SALES, BY USES

Sales of phosphate rock in 1928 were made for a variety of uses. Among these are the manufacture of superphosphates, phosphorus, phosphoric acid, phosphates, and ferrophosphorus; direct application to the soil; raising the phosphorus content of pig iron; as fertilizer filler; as an ingredient of stock and poultry feed; and in building construction.

The following figures are compiled from reports by the producing companies and indicate only in a general way the relative consumption for the different uses in the United States, as the producing companies in many instances do not know the ultimate use to which the material purchased is put by the consumer.

Domestic phosphate rock sold for various uses in 1928, as reported by producers, in long tons

For superphosphates	2, 339, 000
For phosphorus and phosphorus chemicals	181, 000
For direct application to the soil	42, 000
For blast furnace	21, 000
For stock and poultry feed	5, 000
For other uses	15, 000
	2, 603, 000

SUPERPHOSPHATES

The greater part of the phosphate rock sold in the United States goes into the manufacture of the various superphosphates; 90 per cent of the total quantity sold is used thus. In 1928 a total of about 2,339,000 long tons of phosphate rock is reported to have been sold for this purpose. Nearly all of the companies that produced domestic phosphate rock and sold on the domestic market in 1928 reported sales for this purpose. These companies are:

Amalgamated Phosphate Co., 535 Fifth Avenue, New York, N. Y. Mine at Brewster, Fla.

The American Agricultural Chemical Co., 420 Lexington Avenue, New York, N. Y. Mines at Pierce, Fla., and Spring Hill, Tenn.

Anaconda Copper Mining Co. (fertilizer department), Conda, Idaho. Mine at Conda, Caribou County, Idaho.

Armour Fertilizer Works, 111 West Jackson Boulevard, Chicago, Ill. Mine near Columbia, Tenn.

Charleston (S. C.) Mining & Manufacturing Co. and Charleston Mining Co., 11 South Twelfth Street, Richmond, Va. Mines at Gordonsburg and Mountpleasant, Tenn.

Coronet Phosphate Co., 99 John Street, New York, N. Y. Mines at Plant City and Pembroke, Fla.

Federal Chemical Co., Fourth Street and Broadway, Louisville, Ky. Mine at Ridley, Tenn.

Florida Phosphate Mining Corporation, Norfolk, Va. Mine at Royster, Fla.

Hoover & Mason Phosphate Co., 2300 Willoughby Tower, Chicago, Ill. Mine at Mountpleasant, Tenn.

International Agricultural Corporation, 61 Broadway, New York, N. Y. Mines at Mulberry, Fla., and Wales and Mountpleasant, Tenn.

The Phosphate Mining Co., 110 William Street, New York, N. Y. Mines at Nichols, Bartow, and Christina, Fla.

San Francisco Chemical Co., 112 Market Street, San Francisco, Calif. Mine at Montpelier, Bear Lake County, Idaho.

Southern Phosphate Corporation, 1100 Garrett Building, Baltimore, Md. Mines at Eaton Park and Lakeland, Fla.

Swift & Co., Union Stock Yards, Chicago, Ill. Mine near Bartow, Fla.

PHOSPHORUS AND CHEMICALS CONTAINING PHOSPHORUS

The quantity of phosphate rock sold in 1928 for the manufacture of phosphorus and chemicals containing phosphorus (other than superphosphates) was about 181,000 long tons. This is the largest use for phosphate rock other than for the making of superphosphates. The companies reporting the production and sales of phosphate rock in 1928 for the manufacture of phosphorus and chemicals containing phosphorus (other than superphosphates) were:

Amalgamated Phosphate Co., 535 Fifth Avenue, New York, N. Y. Mine at Brewster, Fla.

Anaconda Copper Mining Co. (fertilizer department), Conda, Idaho. Mine at Conda, Caribou County, Idaho.

C. & J. Camp, Ocala, Fla. Mine near Dunnellon, Fla.

Charleston (S. C.) Mining & Manufacturing Co. and Charleston Mining Co., 11 South Twelfth Street, Richmond, Va. Mines at Gordonsburg and Mountpleasant, Tenn.

Coronet Phosphate Co., 99 John Street, New York, N. Y. Mine at Plant City, Fla.

International Agricultural Corporation, 61 Broadway, New York, N. Y. Mines at Mulberry, Fla., and Wales, Tenn.

The Phosphate Mining Co., 110 William Street, New York, N. Y. Mines at Nichols, Bartow, and Christina, Fla.

DIRECT APPLICATION TO THE SOIL

Statistics covering the sales of phosphate rock by producers for direct application to the soil are available since 1914. Sales for this purpose reached a maximum of 79,189 long tons in 1919, declined sharply in the 1921 business depression to 13,503 tons, remained at low levels until 1925, when they increased to about 32,000 tons. In 1928 sales increased to 41,554 long tons, an increase of 26 per cent over 1927. The 1928 sales were 52 per cent of the peak sales of 1919.

Phosphate rock sold by producers in the United States for direct application to the soil, 1919–1928, in long tons

1919	79, 189	1924	14, 320
1920	72, 801	1925	31, 999
1921	13, 503	1926	29, 902
1922	16, 029	1927	32, 957
1923	10, 548	1928	41, 554

Tennessee and Wyoming are reported to have supplied all of the ground rock sold in 1928 for direct application to the soil. By far the greater part came from Tennessee. Various types of phosphate rocks were ground for this purpose in 1928. In Tennessee both the blue and the brown phosphate rock were utilized, but most of the plants ground a washed and dried brown phosphate rock. One of the companies ground a dried brown phosphate rock, from which some of the nonphosphatic material had been removed by air separation. The Wyoming rock used for this purpose was unweathered rock phosphate.

There are fine-grinding mills at the plants of the Amalgamated Phosphate Co., Brewster, Fla.; the Phosphate Mining Co., Nichols, Fla.; and the Lakeland Phosphate & Chemical Co., Bartow, Fla., in the land-pebble district of Florida; and at the plant of the Anaconda Copper Mining Co., Conda, Idaho. None of these companies, however, reported marketing ground rock in 1928 for direct application to the soil.

The producers of phosphate rock in 1928 for direct application to the soil were:

Charleston (S. C.) Mining & Manufacturing Co. and Charleston Mining Co., 11 South Twelfth Street, Richmond, Va. Plants at Gordonsburg and Mountpleasant, Tenn.

Cokeville Phosphate Co., Cokeville, Wyo. Plant at Cokeville, Wyo.

Hoover & Mason Phosphate Co. 2300 Willoughby Tower, Chicago, Ill. Plant at Mountpleasant, Tenn. Ground rock produced is all for account of Ruhm Phosphate & Chemical Co., Mountpleasant, Tenn.

International Agricultural Corporation, 61 Broadway, New York, N. Y. Plant at Wales, Tenn.

New England Phosphate Corporation, Centerville, Tenn. Plant at Centerville, Tenn.

Tennessee-Illinois Phosphate Co., 137 South La Salle Street, Chicago, Ill. Plant at Twomey, Tenn. Sales company, Thomson Phosphate Co., 137 South La Salle Street, Chicago, Ill.

BLAST-FURNACE USE

The phosphate rock sold to blast furnaces for use in raising the phosphorus content of pig iron and in the production of ferrophosphorus by the blast-furnace process, as reported by the producers of phosphate rock, amounted to 21,000 long tons. All of the phosphate rock sold to blast furnaces in 1928 is reported to have come from Tennessee. Companies reporting sales of phosphate rock in 1928 for blast-furnace use were:

Charleston (S. C.) Mining & Manufacturing Co. and Charleston Mining Co., 11 South Twelfth Street, Richmond, Va. Mine at Gordonsburg, Tenn.

Federal Chemical Co., Fourth Street and Broadway, Louisville, Ky. Mines at Century, Ridley, and Southport, Tenn.

International Agricultural Corporation, 61 Broadway, New York, N. Y. Mine at Mountpleasant, Tenn.

Ligon & Huff, Mountpleasant, Tenn. Mine at Southport, Tenn.

STOCK AND POULTRY FEED

The quantity of phosphate rock reported sold in 1928 for use as an ingredient of stock and poultry feed was about 5,000 long tons. Most of the rock sold for this purpose was Tennessee brown phosphate rock, but some sales of Florida land-pebble phosphate were also made. Companies reporting the production and sale of phosphate rock in 1928 for this use were the following:

Charleston (S. C.) Mining & Manufacturing Co. and Charleston Mining Co., 11 South Twelfth Street, Richmond, Va. Mines at Gordonsburg and Mountpleasant, Tenn.

Hoover & Mason Phosphate Co., 2300 Willoughby Tower, Chicago, Ill. Ground rock produced for account of Ruhm Phosphate & Chemical Co., Mountpleasant, Tenn. Mine at Mountpleasant, Tenn.

International Agricultural Corporation, 61 Broadway, New York, N. Y. Mine at Mulberry, Fla.

Tennessee-Illinois Phosphate Co., 137 South La Salle Street, Chicago, Ill. Mine and plant at Twomey, Tenn. Sales company, Thomson Phosphate Co., 137 South La Salle Street, Chicago, Ill.

FERTILIZER FILLER

One company only, the Harsh Phosphate Co., R. F. D. 7, East Station, Nashville, Tenn., sold phosphate rock (Tennessee brown phosphate rock) for use as a fertilizer filler.

BUILDING-CONSTRUCTION TRADE

The Amalgamated Phosphate Co., 535 Fifth Avenue, New York, with phosphate mines at Brewster, Fla., was the only company that reported sales of phosphate rock in 1928 for use in the building-construction trade.

STOCKS

Producers of phosphate rock reported stocks in their hands on December 31, 1928, amounting to 807,200 long tons. Stocks in Florida were a little over 654,000 tons and in Tennessee 151,000 tons. In the Western States stocks on hand were very small. Stocks of wet phosphate rock in the United States were about two and one-half times those of dry rock, and this ratio between wet and dry stocks holds likewise for stocks in Florida. Stocks of wet rock in Tennessee were nearly three times those of dry rock.

Total stocks in hands of producers at the end of 1928 equaled nearly three months' average shipments. Stocks of dry rock on hand, however, were only about three-fourths of an average month's shipments.

REVIEW BY STATES

In 1928 there was an increase in quantity and value of the phosphate rock sold in each of the Eastern States, Florida and Tennessee, and a decrease in both quantity and value in each of the Western States, Idaho and Wyoming. The average value of the phosphate rock sold in Florida decreased 1 cent per ton, and the average value in Tennessee increased 14 cents per ton. The average value of the total production of the Western States decreased $1.63 per ton in 1928.

Phosphate rock sold or used by producers in the United States, 1927 and 1928, by States

State	1927		1928	
	Long tons	Value	Long tons	Value
Florida:				
Hard rock	131,254	$525,016	95,918	$383,672
Land pebble	2,506,166	8,121,146	2,787,528	9,040,350
	2,637,420	8,646,162	2,883,446	9,424,022
Tennessee: Brown and blue rock	481,769	2,318,785	577,095	2,856,850
Western States:				
Idaho	45,260	259,405	37,477	147,908
Wyoming	6,250	29,000	3,388	14,399
	3,170,699	11,253,352	3,501,406	12,443,179

FLORIDA

Florida holds first place in the United States as a producer of phosphate rock and has held this position continuously since 1894, when it took the lead from South Carolina. It was the source of 82 per cent of the total phosphate rock sold or used by producers in the United States in 1928. The marketed production of phosphate rock in Florida rose slightly in 1928, following the decline of the two previous years. The increase was 9.3 per cent in quantity and 9 per cent in value over the 1927 figures. The average value in 1928 was $3.27, 1 cent less than in the previous year.

Land-pebble phosphate rock constituted 96.7 per cent of Florida phosphate rock production in 1928 and hard rock the remaining 3.3 per cent. Three producers of hard rock and eight producers of land pebble reported.

The general trend of hard-rock phosphate production has been downward since 1907. In 1927 there was a slight reaction upward, but in 1928 the downward trend was again resumed, the production decreasing 27 per cent from that of 1927 and touching the lowest point since the World War period. The total value of the 1928 production also decreased 27 per cent. The average value of the hard rock f. o. b. mines in 1928, as reported by the producing companies, was $4 per ton, the same as in 1927 and 1926. The hard-rock deposits worked are about 100 miles north of the land-pebble field, near Dunnellon and Hernando. The overburden is stripped by hydraulic methods and the hard-rock matrix mined by dipper dredges with 1½ cubic yard buckets operating in artificial ponds. The matrix mined is hauled by cable over trestles in 1-bucket-capacity cars to the washers on the edge of the pits, where it is washed and the hard-rock phosphate separated. The greater part of the washed product is shipped to Fernandina, a port on the east coast of Florida, where it is dried and shipped, mostly to European ports. A little hard rock was sold on the domestic market. The companies mining hard rock in 1928 were:

J. Buttgenbach & Co., Dunnellon. Mines at Dunnellon and Hernando.
C. & J. Camp, Ocala. Mine at Dunnellon.
Mutual Mining Co., Savannah, Ga. Mines near Inverness and Dunnellon.

Land-pebble phosphate rock constituted 96.7 per cent of the Florida production in 1928, as against 95 per cent in 1927. The marketed production in 1928 showed an increase of 11 per cent in both quantity and value over 1927. The average value f. o. b. mines was $3.24 a ton in 1928, the same as in 1927. The marketed production in 1927 was 91 per cent of the recent high of 1925 and 85 per cent of the highest land-pebble production yet recorded, that of 1920; in 1928 it advanced to 94 per cent of the 1920 high and passed the 1925 high. Land-pebble exports in 1928 were again the greatest since the opening of the World War and comprised about 29 per cent of the 1928 marketed production.

The Florida land-pebble area of Polk and Hillsborough Counties remains by far the largest individual phosphate rock producing district in the United States. The deposits are flat-lying unconsolidated sediments of Pliocene or later age, reconcentrations from the marine-planated phosphate-bearing Miocene limestone bedrock. The phosphate-bearing material, known locally as "matrix," variable in quantity and thickness, is overlain by variable thicknesses of sand or clay. The overburden is stripped either by drag-line excavators or by hydraulic methods. The matrix is mined entirely by hydraulicking. The material is washed down into sumps and then pumped to washing plants near the pits. The concentrated wet phosphate rock from these washers is transported to the drying plants, where, after partial drying by drainage in wet storage piles, it is dried in oil-fired direct-heat rotary driers.

In 1928 eight companies reported production of land-pebble phosphate rock, as follows:

Amalgamated Phosphate Co., 535 Fifth Avenue, New York, N. Y. Mines at Brewster and Green Bay.
The American Agricultural Chemical Co., 420 Lexington Avenue, New York, N. Y. Mine at Pierce.
Coronet Phosphate Co., 99 John Street, New York, N. Y. Mines at Pembroke and Plant City.
Florida Phosphate Mining Corporation, Norfolk, Va. Mine near Bartow.
International Agricultural Corporation, 61 Broadway, New York, N. Y. Mine at Mulberry.
The Phosphate Mining Co., 110 William Street, New York, N. Y. Mines at Bartow, Nichols, and Christina.
Southern Phosphate Corporation, 1100 Garrett Building, Baltimore, Md. Mines at Eaton Park and Lakeland.
Swift & Co., Union Stock Yards, Chicago, Ill. Mine near Bartow.

An investigation of flotation for low-grade phosphate ores and rejected materials from the Florida washers in the land-pebble district was carried on during 1927 and 1928 at the Southern Experiment Station of the United States Bureau of Mines.[2]

Florida phosphate rock sold or used by producers, 1919–1928

Year	Hard rock			Soft rock		
	Long tons	Value at mines		Long tons	Value at mines	
		Total	Average		Total	Average
1919	285, 467	$2, 452, 563	$8. 59	14, 498	$196, 318	$13. 54
1920	400, 249	4, 525, 191	11. 31	13, 953	190, 551	13. 66
1921	175, 774	1, 806, 671	10. 28	4, 419	20, 153	4. 56
1922	188, 084	1, 308, 201	6. 96	446	3, 500	7. 85
1923	199, 516	1, 071, 675	5. 37	----------	----------	----------
1924	143, 115	629, 579	4. 40	----------	----------	----------
1925	171, 649	707, 933	4. 12	----------	----------	----------
1926	116, 264	465, 308	4. 00	----------	----------	----------
1927	131, 254	525, 016	4. 00	----------	----------	----------
1928	95, 918	383, 672	4. 00	----------	----------	----------

Year	Land pebble			Total		
	Long tons	Value at mines		Long tons	Value at mines	
		Total	Average		Total	Average
1919	1, 360, 235	$5, 149, 048	$3. 79	1, 660, 200	$7, 797, 929	$4. 70
1920	2, 955, 182	14, 748, 620	4. 99	3, 369, 384	19, 464, 362	5. 78
1921	1, 599, 835	8, 604, 818	5. 38	1, 780, 028	10, 431, 642	5. 86
1922	1, 870, 063	7, 035, 821	3. 76	2, 058, 593	8, 347, 522	4. 05
1923	2, 348, 137	7, 987, 752	3. 40	2, 547, 653	9, 059, 427	3. 56
1924	2, 289, 466	7, 387, 897	3. 23	2, 432, 581	8, 017, 476	3. 30
1925	2, 758, 315	8, 081, 137	2. 93	2, 929, 964	8, 789, 070	3. 00
1926	2, 591, 943	8, 218, 200	3. 17	2, 708, 207	8, 683, 508	3. 21
1927	2, 506, 166	8, 121, 146	3. 24	2, 637, 420	8, 646, 162	3. 28
1928	2, 787, 528	9, 040, 350	3. 24	2, 883, 446	9, 424, 022	3. 27

Quotations for Florida land-pebble phosphate rock at the end of the year are given in the following table. The rapid rise in the prices of phosphate rock from the lower to the higher grades is related not only to the increased total content of tricalcium phosphate (known to industry as "B. P. L." or "bone phosphate of lime") but reflects also an increased value per unit of tricalcium phosphate in the higher grades.

Prices of pebble phosphate per long ton, f. o. b. Florida[3]

Export prices:		Domestic prices:	
76 to 77 per cent	$7. 00	76 to 77 per cent	$6. 50
75 per cent	6. 25	74 to 75 per cent	5. 50
74 to 75 per cent	6. 00	72 per cent	4. 50
70 per cent	4. 50	70 per cent	4. 00
68 per cent	4. 10		

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[2] Lawrence, H. M., and De Vaney, F. D., Flotation of Low-Grade Phosphate Ores: Repts. of Investigations, Serial 2860, Bureau of Mines, 1928.

Lawrence, H. M., Losses of Phosphate in the Land-Pebble District of Florida: Repts. of Investigations, Serial 2925, Bureau of Mines, 1929.

[3] Engineering and Mining Journal, vol. 127, No. 1, Jan. 5, 1929, p. 38.

TENNESSEE

Tennessee is the second largest producer of phosphate rock, ranking next to Florida, and has maintained this position since it passed South Carolina in 1899. The phosphate deposits at present worked are in the west-central part of the State. Two types of rock are now mined—"brown phosphate rock" and "blue phosphate rock." The brown phosphate rock is the residual weathered and leached outcrop of the phosphatic Ordovician limestones exposed over a wide area in the southern part of the central basin of Tennessee, where erosion of that basin in the summit of the Nashville dome has exposed the underlying Ordovician phosphatic limestones to weathering. The so-called blue phosphate rock is a thin, unweathered, highly phosphatic stratum of Devonian or Carboniferous (Mississippian) age occurring in the western part of the phosphate region.

The overburden of the brown rock phosphate is clay and is removed at the larger operations with drag-line excavators. The brown rock is mined by drag-line excavators whenever possible. Where the phosphate is thin or lies in narrow channels ("cutters") in the limestone and can not be mined by the drag-line excavators it is mined by pick and shovel. Steam shovels and hydraulic methods are no longer used for stripping or mining. An electric shovel is used near Nashville in mining brown phosphate rock for use as a fertilizer filler. The blue rock is mined by underground methods, drift mining by single-entry room-and-pillar system.

Most of the brown rock mined is washed later. Lump phosphate rock suitable for furnace use is either removed in the course of hand mining or is taken out by screens in the early stages of washing. The first step in the washing process is to disintegrate the material by thorough agitation (usually in log washers) with water. After all the clay and fine sand are in suspension the coarser phosphatic material is removed by screening. The next step is to separate the finer phosphatic grains from the clay in mechanical or hydraulic classifiers. The excess moisture in the wet rock from the washers is allowed to drain off in outdoor storage piles, and then the product is dried further in coal-fired direct-heat rotary driers.

The blue phosphate rock requires only crushing and drying before shipment.

The tonnage of phosphate rock sold or used by producers in Tennessee in 1928 was the third highest in the history of the phosphate rock mining industry in that State, the two previous higher years being 1907 and 1920. After the Tennessee fields were opened in 1894 production climbed rapidly to 1899, then more slowly to 1907, when it reached a maximum of 638,612 long tons. The growth of the industry was curtailed by the depression of 1908. Slow recovery followed to a second peak of 621,396 tons in 1920. The depression of 1921 was a more serious blow to the Tennessee industry than that of 1909, for the marketed production fell to 264,159 tons, the lowest since 1897. Even the 577,095 long tons sold or used by Tennessee producers in 1928 is only 90.4 per cent of the maximum annual figure thus far recorded, that of 1907.

More than 90 per cent of the phosphate rock production of Tennessee comes from the brown-rock fields. The remainder is blue rock, but as only one mine produced blue rock in 1928—the Mayfield mine at Gordonsburg—this production can not be shown separately and is therefore combined with the figures for brown rock.

In 1928 14 phosphate rock mining companies were operating in Tennessee, as follows:

The American Agricultural Chemical Co., 420 Lexington Avenue, New York, N. Y. Mine at Spring Hill.

Armour Fertilizer Works, 111 West Jackson Boulevard, Chicago, Ill. Mines near Columbia.

Charleston (S. C.) Mining & Manufacturing Co. and Charleston Mining Co., 11 South Twelfth Street, Richmond, Va. Mines at Gordonsburg and Mountpleasant.

J. K. Davis, Mountpleasant. Mine at Mountpleasant.

Federal Chemical Co., Fourth Street and Broadway, Louisville, Ky. Mine at Southport, Century, and Ridley.

Harsh Phosphate Co., R. F. D. 7, East Station, Nashville. Mine near Nashville.

Hoover & Mason Phosphate Co., 2300 Willoughby Tower, Chicago, Ill. Mine at Mountpleasant.

International Agricultural Corporation, 61 Broadway, New York, N. Y. Mines at Mountpleasant and Wales.

J. J. Jones, Mountpleasant. Mine at Mountpleasant.

S. T. Jones, Mountpleasant. Mine at Mountpleasant.

W. A. Kittrell & Co., Mountpleasant.

Ligon & Huff (successors in 1928 to Huff & Ligon), Mountpleasant. Mine at Southport.

New England Phosphate Corporation, Centerville. Mine at Centerville.

Tennessee-Illinois Phosphate Co., 137 South La Salle Street, Chicago, Ill. Mine at Twomey.

New developments in the phosphate rock industry in Tennessee in 1928 include completion of a new washing unit by the International Agricultural Corporation; the erection of a new 2-dryer unit by the Charleston Mining Co.; the erection of a phosphoric acid and multiple superphosphate plant by Armour & Co.; and the erection of a blast furnace for the manufacture of phosphoric acid by the Victor Chemical Co.

Tennessee phosphate rock sold or used by producers, 1919–1928

Year	Brown rock			Blue rock			Total		
	Long tons	Value at mines		Long tons	Value at mines		Long tons	Value at mines	
		Total	Average		Total	Average		Total	Average
1919	465,783	$3,056,741	$6.56	58,550	$290,951	$4.97	524,333	$3,347,692	$6.38
1920	542,725	4,339,165	8.00	78,671	518,234	6.59	621,396	4,857,399	7.82
1921	238,996	1,574,621	6.59	25,163	146,198	5.81	264,159	1,720,819	6.51
1922	329,949	1,951,539	5.91	9,078	51,803	5.71	339,027	2,003,342	5.91
1923	414,792	2,249,393	5.42	919	5,647	6.14	415,711	2,255,040	5.42
1924	367,319	1,894,422	5.16	21,378	81,766	3.82	388,697	1,976,188	5.08
1925	[1] 464,240	[1] 2,334,995	[1] 5.03	(1)	(1)	(1)	464,240	2,334,995	5.03
1926	[1] 455,395	[1] 1,980,613	[1] 4.35	(1)	(1)	(1)	455,395	1,980,613	4.35
1927	[1] 481,769	[1] 2,318,785	[1] 4.81	(1)	(1)	(1)	481,769	2,318,785	4.81
1928	[1] 577,095	[1] 2,856,850	[1] 4.95	(1)	(1)	(1)	577,095	2,856,850	4.95

[1] Blue rock included with brown rock.

WESTERN STATES

The growth of the phosphate rock industry in the Western States suffered a decided setback in 1928. These States usually furnish between 1 and 2 per cent of the total marketed production of the United States. In 1927 they supplied 1.6 per cent of the total, but in 1928 the decline in the production of the Western States, coupled with the increase for the country as a whole, caused lowering of their share to 1.2 per cent of the total.

The total quantity of phosphate rock sold or used by the producers of the Western States in 1928 was 40,865 long tons, a decrease of 21 per cent from the 1927 production. Declines were registered both in Idaho and Wyoming. In 1928 Idaho produced 37,477 long tons as against 45,260 tons in 1927, and Wyoming 3,388 long tons in 1928 as against 6,250 tons the previous year.

The 1928 figures for the Western States are considerably below the peak of 1920 and only 56 per cent of the maximum of 72,631 long tons in 1925.

The average value per ton of the rock sold in 1928 declined to $3.97, a decrease of $1.63 as compared with 1927, and is the lowest average value since 1918.

Western States phosphate rock sold or used by producers, 1919–1928

Year	Long tons	Value at mines		Year	Long tons	Value at mines	
		Total	Average			Total	Average
1919	16,935	$69,855	$4.12	1924	38,570	$194,569	$5.04
1920	55,609	304,006	5.47	1925	72,631	319,498	4.40
1921	6,291	25,872	4.11	1926	37,577	162,020	4.31
1922	4,481	19,692	4.39	1927	51,510	288,405	5.60
1923	30,335	175,713	5.79	1928	40,865	162,307	3.97

Three phosphate rock producing companies were operating in the Western States in 1928, two in Idaho and one in Wyoming. They were as follows:

Anaconda Copper Mining Co. (fertilizer department), Conda, Caribou County, Idaho.

San Francisco Chemical Co., 112 Market Street, San Francisco, Calif. Mine at Montpelier, Bear Lake County, Idaho.

Cokeville Phosphate Co., Cokeville, Lincoln County, Wyo.

The western phosphate rock deposits are oolitic phosphatic marine strata of Permian age. The productive beds are thick, 5 feet or more, and carry 30 per cent and more of phosphoric acid. The phosphate rock is mined by underground methods. The freshly mined rock is relatively dry, but some of the producers run it through a dryer before shipping. It is being used chiefly in the manufacture of superphosphates. The larger portion of the production—that from the Anaconda Copper Mining Co. phosphate mine at Conda, Idaho—is shipped to Anaconda, Mont., where it is made into treble superphosphate, phosphoric acid, and ammonium phosphate. The production of the San Francisco Chemical Co. is shipped to California, where it is made into superphosphate. In 1928 the phosphate rock from Cokeville, Wyo., was reported to have been used for direct application to the soil.

OTHER STATES

Phosphate rock deposits in the United States in the Carolinas, Kentucky, Arkansas, and other States have recently been unproductive. Kentucky and South Carolina, which have been the more important of these States, ceased producing in 1926 and 1925, respectively. The record of production for 10 years is given in the following table:

Kentucky and South Carolina phosphate rock sold or used by producers, 1919–1928

Year	Kentucky			South Carolina		
	Long tons	Value at mines		Long tons	Value at mines	
		Total	Average		Total	Average
1919	9,692	$66,824	$6.89	60,823	$308,968	$5.08
1920	13,452	86,596	6.44	44,141	367,209	8.32
1921	13,547	91,737	6.77			
1922	14,282	104,040	7.28	1,500	8,250	5.50
1923	13,007	85,869	6.60			
1924	7,941	63,850	8.04			
1925	12,837	94,064	7.33	2,147	8,051	3.75
1926	8,797	67,659	7.69			
1927–28						

EXPORTS

PHOSPHATE ROCK

Foreign markets apparently play a relatively less important part than formerly in the phosphate rock industry of the United States. The export trade, although increasing fairly steadily, is not keeping pace with the growth of domestic consumption. Consequently, despite the increasing production of phosphate rock in the United States and the increasing quantity exported, the proportion of exports to the total marketed production of phosphate rock in the United States has declined steadily from 36 per cent of the marketed production in 1921 to only 26 per cent in 1928.

The total exports of phosphate rock from the United States in 1928 (898,764 long tons) decreased but 2 per cent in quantity and 6 per cent in value from those in 1927. The decline in quantity was due to the fact that the increased shipments of land pebble did not quite offset the marked decline in the tonnage of the high-grade rock shipments. The values of both the high-grade phosphate rock and the land pebble exported in 1928 were lower than in the preceding year. With the exception of 1927, however, the quantity of phosphate rock exported from the United States in 1928 was higher than in any year since 1920.

The general trend of the total phosphate rock export tonnage from the United States since 1921 has been upward at a low but uniform rate of increase, although at a lower rate than prevailed prior to the World War. On the other hand, the exports of phosphate rock from the United States to Europe, the principal world market for crude phosphate rock, have been steadily declining since 1921, owing to the increasing competition offered by the North African phosphate rock.

Of the total exports from the United States in 1928, 680,566 long tons, or 76 per cent, went to Europe, as against 708,611 tons, or 77 per cent, of the exports in 1927. The land-pebble exports to Europe in 1928 increased 13,437 long tons, and the high-grade phosphate rock exports decreased 41,482 long tons, as compared with 1927. Asia (Japan) took 20 per cent of the total United States exports of phosphate rock in 1928, and North America (Canada and Cuba) took 4 per cent.

Germany was the best customer of the phosphate rock industry of the United States in 1928, taking a total of 216,249 long tons, or 24 per cent of all the phosphate rock exported from the United States. Of this, 49,318 tons were high-grade phosphate rock and 166,931 tons were land pebble. Japan ranked second as a consumer of phosphate rock from the United States, taking 20 per cent of the total exports. Netherlands stood third with 16 per cent, Italy fourth with 11 per cent, and Spain fifth with 8 per cent.

Hard-rock (high-grade rock) exports continued the irregular decline which started from the postwar peak of 1920. In 1928 there was a decline from the previous year of 30 per cent in the total quantity of hard rock exported and of 31 per cent in the value. The decline in tonnage was due chiefly to decreased shipments to Germany, exports to which country decreased 45,407 long tons, although declines were also registered in Belgium, Poland and Danzig, and Norway, but exports to Netherlands more than trebled. A slight increase occurred in the exports to Canada, while Sweden was again listed as a market.

Europe remains the leading market for high-grade rock, taking 96 per cent of the total high-grade rock exports from the United States in 1928. These shipments were all to northwestern Europe, more to Germany than to all the other European countries combined. North America (Canada) took 4 per cent.

Since 1920 Germany has been by far the best customer for Florida high-grade rock, and in 1928 that country took 55 per cent of the total exports of high-grade rock and 57 per cent of the total shipments of that kind of rock to Europe. Netherlands took the second largest tonnage in 1928, 13 per cent of the total exports of high-grade rock, followed by Sweden, 12 per cent, and Belgium, 10 per cent.

The average value per ton of the high-grade rock exported in 1928 was $6.86. The average value per ton of the exports to the individual countries ranged from $6.72 to $7.44. The average value at the mine of the hard rock sold in 1928, as reported by the producing companies, was $4.

The quantity of "land-pebble and other" phosphate rock exported in 1928 made a new postwar high, exceeding that of 1927 by 19,625 long tons, or 2 per cent. Germany accounted for 41,270 tons more than in 1927, shipments to Japan increased by 52,678 tons, and there were smaller increases ranging from 1,000 to 8,600 tons in the exports to Italy, Belgium, Spain, and Netherlands. Yugoslavia and Albania, Czechoslovakia, and Lithuania received shipments of land pebble for the first time. Among the countries that registered a decrease in 1928, Denmark took 27,808 tons less than in 1927; the United Kingdom, 18,753 tons; Cuba, 9,597 tons; and Poland and Danzig, 2,867 tons. Australia and British South Africa, to which appreciable quantities of land pebble have been sold in recent years, did not figure in the 1928 trade.

Seventy-three per cent of the land-pebble exports went to Europe, 23 per cent to Asia (Japan), and 4 per cent to North American countries (Canada and Cuba). Although the largest continental market for land pebble was Europe, the leading consuming country was Japan, which took 23 per cent of the total exports of land pebble. Germany, however, was a close second, taking 21 per cent, followed by Netherlands with 16 per cent and Italy with 12 per cent of the total.

The average value of the "land-pebble and other" phosphate rock exported in 1928 was $4.74, as against $4.87 in 1927. The range in values was from $3.57 for the exports to Japan to $6.40 for those to Canada. A shipment of 1 ton to Mexico was valued at $14.

Phosphate rock, ground or unground, exported from the United States, 1919–1928

Year	High-grade rock		Land pebble		Other		Total	
	Long tons	Value	Long tons	Value	Long tons	Value	Long tons	Value
1919	215,039	$2,261,852	128,860	$904,308	34,832	$401,822	378,731	$3,567,982
1920	344,896	4,496,457	693,355	5,593,814	31,461	479,904	1,069,712	10,570,175
1921	182,594	2,592,541	544,425	4,627,875	6,293	99,721	733,312	7,320,137
1922	202,300	2,548,587	512,777	3,269,179	4,217	40,401	719,294	5,858,167
1923	194,339	2,477,501	630,565	3,273,006	2,647	21,664	827,551	5,772,171
1924	150,746	1,814,194	656,005	3,209,965	12,022	96,673	818,773	5,120,832
1925	158,985	2,283,076	697,891	3,287,370	13,324	107,317	870,200	5,677,763
1926	103,572	1,195,729	634,362	3,155,732	11,029	84,129	748,963	4,435,590
1927	128,774	888,732	[1] 789,437	[1] 3,842,830	(1)	(1)	918,211	4,731,562
1928	89,702	615,682	[1] 809,062	[1] 3,837,419	(1)	(1)	898,764	4,453,101

[1] "Other" included with land pebble; not separately recorded.

Phosphate rock, ground or unground, not acidulated, exported from the United States, 1924–1928, by countries

HIGH-GRADE ROCK

Country	1924		1925		1926		1927		1928	
	Long tons	Value	Long tons	Value	Long tons	Value	Long tons	Value	Long tons	Value
Australia					12,500	$187,500				
Belgium	19,500	$292,500	28,000	$420,000	16,125	219,275	11,950	$81,820	9,000	$63,000
Canada			1,490	7,826	2,443	10,784	1,145	6,747	3,559	26,488
France							1,050	7,350		
Germany	92,021	1,031,819	90,374	1,284,285	23,525	232,775	94,725	653,495	49,318	331,419
Mexico					4	70				
Netherlands	26,494	355,195	35,221	512,465	12,175	152,225	3,550	24,850	11,425	79,975
New Zealand					12,625	136,575				
Nicaragua							4	20		
Norway					2,100	36,500	4,200	29,400	2,100	14,700
Poland and Danzig	6,000	90,000	3,900	58,500	8,775	106,925	12,150	85,050	3,600	25,200
Sweden	6,731	44,680			13,300	113,100			10,700	74,900
	150,746	1,814,194	158,985	2,283,076	103,572	1,195,729	128,774	888,732	89,702	615,682

Phosphate rock, ground or unground, not acidulated, exported from the United States, 1924–1928, by countries—Continued

LAND PEBBLE[1]

Country	1924		1925		1926		1927		1928	
	Long tons	Value	Long tons	Value	Long tons	Value	Long tons	Value	Long tons	Value
Australia	------	--------	------	--------	36, 236	$227, 257	27, 332	$165, 492	------	--------
Belgium	38, 469	$196, 636	36, 731	$184, 338	43, 551	220, 443	20, 716	104, 186	25, 492	$128, 313
British South Africa	6, 620	34, 755	21, 592	117, 456	13, 513	75, 297	10, 380	59, 685	------	--------
Canada	7, 019	40, 551	12, 957	65, 987	14, 060	74, 832	17, 848	104, 173	18, 666	119, 519
Cuba	33, 672	156, 455	5, 825	31, 815	14, 529	70, 754	21, 754	106, 773	12, 157	65, 108
Czechoslovakia	------	--------	------	--------	------	--------	------	--------	3, 000	15, 300
Denmark	38, 072	171, 176	39, 783	189, 011	69, 868	362, 541	43, 755	193, 224	15, 947	73, 721
Finland	------	--------	------	--------	------	--------	9, 269	50, 426	------	--------
France	8, 798	43, 641	3, 310	15, 343	------	--------	------	--------	------	--------
Germany	129, 213	628, 143	92, 946	529, 072	65, 559	338, 440	125, 661	693, 367	166, 931	803, 549
Irish Free State	(2)	(2)	3, 300	10, 725	------	--------	------	--------	------	--------
Italy	58, 419	290, 391	69, 927	330, 373	86, 927	439, 382	87, 612	409, 193	96, 256	513, 526
Japan	45, 733	161, 423	95, 245	281, 401	95, 809	343, 473	131, 137	480, 780	183, 815	656, 839
Latvia	------	--------	------	--------	------	--------	12, 139	63, 198	12, 206	62, 885
Lithuania	------	--------	------	--------	------	--------	------	--------	3, 994	24, 963
Mexico	------	--------	------	--------	------	--------	------	--------	1	14
Netherlands	97, 368	472, 666	100, 293	475, 832	65, 373	330, 904	127, 981	606, 491	129, 035	636, 641
New Zealand	------	--------	------	--------	6, 162	33, 891	------	--------	------	--------
Norway	2, 000	9, 000	3, 150	14, 375	------	--------	------	--------	------	--------
Poland and Danzig	13, 366	70, 420	10, 900	69, 315	3, 139	19, 776	25, 204	155, 943	22, 337	128, 097
Spain	110, 146	648, 779	108, 485	551, 329	94, 522	518, 802	72, 363	369, 350	76, 051	369, 328
Sweden	12, 023	64, 762	61, 233	294, 504	5, 839	32, 115	29, 794	175, 466	29, 160	178, 921
United Kingdom:										
England	33, 805	134, 774	32, 214	126, 494	19, 275	67, 825	26, 492	105, 083	7, 739	29, 020
Ireland	3, 000	9, 000								
Scotland	18, 282	77, 393								
Yugoslavia and Albania	------	--------	------	--------	------	--------	------	--------	6, 275	31, 675
	656, 005	3, 209, 965	697, 891	3, 287, 370	634, 362	3, 155, 732	789, 437	3, 842, 830	809, 062	3, 837, 419

ALL OTHER PHOSPHATE ROCK[1]

Country	1924		1925		1926		1927		1928	
	Long tons	Value	Long tons	Value	Long tons	Value	Long tons	Value	Long tons	Value
Belgium	------	--------	------	--------	500	$2, 000	(1)	(1)	(1)	(1)
Canada	10, 941	$80, 246	13, 324	$107, 317	6, 649	61, 301				
Cuba	81	1, 427	------	--------	------	--------				
Dominican Republic	------	--------	------	--------	60	200				
Netherlands	------	--------	------	--------	3, 820	20, 628				
Norway	1, 000	15, 000	------	--------	------	--------				
	12, 022	96, 673	13, 324	107, 317	11, 029	84, 129	(1)	(1)	(1)	(1)

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[1] Classification for 1927 and 1928 reads "Land pebble and other"; not separately recorded.
[2] Included under "United Kingdom."

SUPERPHOSPHATES AND OTHER FERTILIZER MATERIALS

The exports of superphosphate, which had shown a practically consistent increase from 1922 to 1927, were lower in 1928 both in quantity (18 per cent) and value (6 per cent) than those of 1927, a year that constituted the all-time peak in superphosphate exports since statistics on exports of superphosphates were first recorded separately in 1917. The tonnage of the 1928 exports of superphosphate exceeded that of any year previously recorded, with the exception of 1927, but the values both in 1927 and 1928 were exceeded in 1919 and 1920. In 1928 shipments to Canada and Cuba constituted 91 per cent of the superphosphate exports of the United States, Canada alone taking 78 per cent of this total. Both of these near-by markets showed declines in 1928, Canada declining about

7,500 tons, or 10 per cent, and Cuba nearly 13,000 tons, or 55 per cent. The only marked increase in 1928 was in the case of Japan, where the exports advanced from 1,500 tons in 1927 to 2,800 in 1928, and in Brazil, which for the first time in recent years appeared as a market for exports of superphosphate from the United States, taking 2,100 tons.

Nitrogenous fertilizer materials and prepared fertilizer mixtures exported in 1928 continued to decline both in quantity and value in 1928.

Fertilizers exported from the United States, 1919–1928

Year	Superphosphates (acid phosphates)		Prepared fertilizer mixtures		Nitrogenous fertilizer materials				All other fertilizers	
					Sulphate of ammonia		Other			
	Long tons	Value	Long tons	Value	Long tons	Value	Long tons	Value	Long tons	Value
1919	86,790	$2,774,856	(1)	(1)	(1)	(1)	(1)	(1)	188,586	$14,567,032
1920	80,993	2,949,629	(1)	(1)	(1)	(1)	(1)	(1)	205,666	15,602,658
1921	4,278	96,303	(1)	(1)	(1)	(1)	(1)	(1)	55,239	2,602,277
1922	26,781	372,279	14,416	$690,972	147,331	$8,736,611	[2] 4,219	[2] $110,386	25,462	898,061
1923	42,099	534,446	17,997	832,948	153,677	11,117,726	13,291	614,814	45,073	1,921,972
1924	45,751	588,620	35,793	1,695,472	118,367	6,918,598	4,699	283,154	44,942	1,901,722
1925	65,779	988,914	29,923	1,530,354	123,141	6,748,728	6,802	367,435	46,509	1,985,335
1926	64,452	937,278	26,439	1,009,402	181,125	9,823,847	9,639	566,306	72,164	3,267,562
1927	107,507	1,615,466	14,720	617,582	138,692	6,826,600	8,951	492,004	82,962	3,440,961
1928	88,613	1,510,577	26,414	936,111	93,015	4,373,162	7,772	323,909	104,260	4,497,949

[1] Not separately classified.

[2] Includes 2,556 tons of calcium cyanamid (lime of nitrogen), valued at $26,112; not separately classified for other years.

IMPORTS

Both the total quantity and total value of the phosphatic fertilizers imported into the United States were much greater in 1928 than in 1927. This was especially true with respect to imports of the bone-dust group, of crude phosphates, and of basic slag. The imports of guano, the remaining phosphatic fertilizer, decreased in quantity, but showed a marked increase in value.

The imports of crude phosphate rock into the United States in 1928 were the highest of any year since import statistics on this commodity have been available, except for a period of a few years (1898–1905) following the Spanish-American War, during which time the maximum importation of phosphate rock into the United States, 175,765 long tons, was reached. The quantity of crude phosphate rock imported increased 62 per cent, while the value increased 47 per cent. The average value of the phosphate rock imported into the United States in 1928 was $9.41, a decrease of $0.98 from that of 1927, and the lowest average annual value since 1916.

About 75 per cent of the phosphate rock imported into the United States in 1928 came from French possessions. Of the total imports, amounting to 45,812 long tons, 20,572 tons from French Morocco entered eastern United States and 13,371 tons from French Oceania entered the Hawaiian Islands. The imports of phosphate rock from French Morocco in 1927, the first year in which phosphate rock from that country entered the United States in large quantity, were 10,641 tons, so that the 1928 imports represent an increase of 93 per cent over 1927.

Phosphate rock, crude, imported into the United States, 1924–1928, by countries

[General imports]

Country	1924		1925		1926		1927		1928	
	Long tons	Value	Long tons	Value	Long tons	Value	Long tons	Value	Long tons	Value
Belgium			38	$7,836	13	$1,120				
Canada	98	$865	138	2,606	624	15,057	116	$3,222	104	$3,284
Cuba			2,500	25,000	4,239	37,362			11,752	141,544
France									(1)	5
Germany					(1)	6	45	1,115		
Japan							2	44		
Morocco, French			1	12			10,641	48,635	20,572	103,199
Oceania:										
British					2	21				
French	10,500	135,870			10,000	116,000	17,391	239,855	13,371	183,170
United Kingdom			58	2,478	2,500	23,045				
West Indies: Netherland	5,500	44,780							13	36
	16,098	181,515	2,735	37,932	17,378	192,611	28,195	292,871	45,812	431,238

[1] Less than 1 ton.

Imports of the bone-dust group increased 51 per cent in quantity and 67 per cent in value over 1927. The quantity of basic slag imported increased for the third successive year, reaching 2,822 tons in 1928, an increase of 74 per cent over 1927. The value increased 68 per cent. The quantity of guano imports decreased 3 per cent from the 1927 figures, but the value increased 17 per cent. The average value of the guano imported in 1927 was $38.51; that in 1928, $46.35.

Phosphatic fertilizers (other than crude phosphate rock) imported for consumption in the United States, 1924–1928

Fertilizer	1924		1925		1926		1927		1928	
	Long tons	Value	Long tons	Value	Long tons	Value	Long tons	Value	Long tons	Value
Bone dust, or animal carbon, and bone ash, fit only for fertilizing	22,242	$706,727	24,981	$724,473	46,715	$1,380,103	54,586	$1,540,897	82,460	$2,566,686
Guano	25,241	754,234	17,407	730,046	11,673	430,203	23,321	898,205	22,584	1,046,834
Slag, basic, ground or unground	703	9,598	181	2,815	269	3,485	1,025	18,945	2,822	31,879

CONSUMPTION OF PHOSPHATE ROCK IN THE UNITED STATES

The table that accompanies this section shows the annual apparent consumption of phosphate rock in the United States and also the annual consumption of domestic phosphate rock. There is comparatively little difference in the two sets of figures, as imports are as yet relatively small, the home demand being largely satisfied from domestic production.

The greatest annual consumption of phosphate rock in the United States was in 1920, when a total of 3,034,333 long tons of phosphate rock was apparently consumed. The depression of 1921 cut the consumption over one-half, lowering it to 1,334,248 tons. There was a general upward trend in the amount consumed annually after this depression until 1925, when it reached 2,614,354 tons. After a nominal reaction for two years the apparent consumption mounted to 2,648,454 tons in 1928.

Phosphate rock consumed in the United States, 1919–1928, in long tons

Year	Marketed production	Imports	Exports	Apparent consumption	
				Total[1]	Domestic rock[2]
1919	2,271,983	34	378,731	1,893,286	1,893,252
1920	4,103,982	63	1,069,712	3,034,333	3,034,270
1921	2,064,025	3,535	733,312	1,334,248	1,330,713
1922	2,417,883	5,890	719,294	1,704,479	1,698,589
1923	3,006,706	6,725	827,551	2,185,880	2,179,155
1924	2,867,789	16,098	818,773	2,065,114	2,049,016
1925	3,481,819	2,735	870,200	2,614,354	2,611,619
1926	3,209,976	17,378	748,963	2,478,391	2,461,013
1927	3,170,699	28,195	918,211	2,280,683	2,252,488
1928	3,501,406	45,812	898,764	2,648,454	2,602,642

[1] Marketed production plus imports minus exports.
[2] Marketed production minus exports.

LIST OF CONSUMERS OF PHOSPHATE ROCK, BY USES

The following list of consumers of phosphate rock has been classified according to the principal phosphate-containing products manufactured by the different companies from phosphate rock. Consumers of phosphate rock for direct application to the soil are not listed, and there has been no attempt to list the consumers for production of by-products, such as sodium silicofluoride, or for some of the smaller uses, such as concrete aggregate, road metal, and fillers for various purposes. This list has been compiled through the cooperation of both the producers and consumers of phosphate rock and others interested in the phosphate rock industry. The list of iron furnaces using phosphate rock was obtained through the hearty cooperation of the iron and steel companies of this country. Some of the names of the superphosphate producing companies were obtained from the American Fertilizer Handbook, others by correspondence with the superphosphate companies.

Consumers of phosphate rock for the manufacture of superphosphates

Acme Manufacturing Co., Wilmington, N. C.
Alabama Chemical Co., Montgomery, Ala.
American Agricultural Chemical Co., 420 Lexington Avenue, New York, N. Y.
Anaconda Copper Mining Co. (fertilizer department), 111 West Washington Street, Chicago, Ill.
Anderson Fertilizer Co. (Inc.), Anderson, S. C.
Arkansas Fertilizer Co., Little Rock, Ark.
Armour Fertilizer Works, 111 West Jackson Boulevard, Chicago, Ill.
Barker Chemical Co., Savannah, Ga.
Baugh & Sons Co., 20 South Delaware Avenue, Philadelphia, Pa.
Baugh Chemical Co., 25 South Calvert Street, Baltimore, Md.
Blackshear Manufacturing Co., Blackshear, Ga.
D. Brown Guano Co., Albany, Ga.
Calumet Fertilizer Corporation, 61 Broadway, New York, N. Y.
Capital City Acid Phosphate Co., Little Rock, Ark.

Capital Fertilizer Co., Montgomery, Ala.
Caraleigh Phosphate & Fertilizer Works, Raleigh, N. C.
Catawba Fertilizer Co., Lancaster, S. C.
Central Chemical Co., Hagerstown, Md.
Chickamauga Fertilizer Works, Atlanta, Ga.
Columbus Fertilizer Co., Columbus, Ga.
Congaree Fertilizer Co., Palmetto Building, Columbia, S. C.
Contentnea Guano Co., Wilson, N. C.
Cotton States Fertilizer Co., Macon, Ga.
Darling & Co., 4201 South Ashland Avenue, Chicago, Ill.
Davison Chemical Co., Garrett Building, Baltimore, Md.
Davison-Pick Fertilizers (Inc.), New Orleans, La.
Diamond Fertilizer Co., Commercial Bank Building, Sandusky, Ohio
Dixie Guano Co., Laurinburg, N. C.
Dockwiler & Kingsbury Co., East Thirtieth and Emerson Avenue, Indianapolis, Ind.
Empire State Chemical Co., Athens, Ga.
Etiwan Fertilizer Co., Charleston, S. C.
Farmers' Fertilizer Co., Windsor Avenue and Cleveland, Akron & Cincinnati Railroad, Columbus, Ohio.
Farmers' Guano Co., Norfolk, Va.
Federal Chemical Co., Fourth Street and Broadway, Louisville, Ky.
Furman Fertilizer Works, Atlanta, Ga.
Georgia Fertilizer Co., Valdosta, Ga.
Grasselli Chemical Co., Birmingham, Ala.
Griffith & Boyd Co., Keyser Building, Baltimore, Md.
Groves Fertilizer Works, Cincinnati, Ohio.
Gulfport Fertilizer Co., Gulfport, Miss.
M. Hamm Co., Washington Court House, Ohio.
Hartsville Fertilizer Co., Hartsville, S. C.
Home Guano Co., Dothan, Ala.
International Agricultural Corporation, 61 Broadway, New York, N. Y.
Jackson Fertilizer Co., Jackson, Miss.
Jarecki Chemical Co., 111 West Jackson Boulevard, Chicago, Ill.
N. B. Josey Guano Co., Wilmington, N. C.
King Chemical Co., Bound Brook, N. J.
Knoxville Fertilizer Co., Bankers Trust Building, Knoxville, Tenn.
Laurel Oil & Fertilizer Co., Laurel, Miss.
Lowell Fertilizer Co., Boston, Mass.
McCabe Fertilizer Co., Charleston, S. C.
Mandeville Mills, Carrollton, Ga.
Maybank Fertilizer Co., Charleston, S. C.
Merchants Fertilizer & Phosphate Co., Charleston, S. C.
Meridian Fertilizer Factory, Citizens National Bank Building, Meridian, Miss.
Miller Fertilizer Co., Garrett Building, Baltimore, Md.
Montezuma Fertilizer Co., Montezuma, Ga.
Morris Fertilizer Co., Chicago, Ill.
Mountain Copper Co. (Ltd.), 332 Pine Street, San Francisco, Calif.
Mutual Fertilizer Co., Savannah, Ga.
G. Ober & Sons Co., 110 East Lombard Street, Baltimore, Md.
Pacific Guano & Fertilizer Co., Matson Building, San Francisco, Calif.
Pelham Phosphate Co., Pelham, Ga.
Pennsylvania Salt Manufacturing Co., Widener Building, Philadelphia, Pa.
Piedmont-Mt. Airy Guano Co., Keyser Building, Baltimore, Md.
Pittsburgh Provision & Packing Co., Herrs Island, Pittsburgh, Pa.
Planters' Chemical & Oil Co., Talladega, Ala.
Planters' Fertilizer & Phosphate Co., Charleston, S. C.
Porter Fertilizer Works, Atlanta, Ga.
Powhatan Fertilizer Co., Greenville, S. C.
E. Rauh & Sons Fertilizer Co., Union Stock Yards, Indianapolis, Ind.
Read Phosphate Co., Savannah, Ga.
Reading Bone Fertilizer Co., Reading, Pa.
Redd Chemical & Nitrate Co., Birmingham, Ala.
Reliance Fertilizer Co., Savannah, Ga.
Richmond Guano Co., Richmond, Va.
Roanoke Guano Co., Roanoke, Ala.
Robertson Chemical Corporation, Norfolk, Va.
F. S. Royster Guano Co., Norfolk, Va.

Shreveport Fertilizer Works, Shreveport, La.
Smith Agricultural Chemical Co., Columbus, Ohio.
Southern Agricultural Chemical Corporation, 61 Broadway, New York, N. Y.
Southern Fertilizer & Chemical Co., Savannah, Ga.
Southern States Phosphate & Fertilizer Co., Augusta, Ga.
Standard Chemical Co., Troy, Ala.
Standard Fertilizer Co., Gainesville, Fla.
Standard Wholesale Phosphate & Acid Works (Inc.), Continental Building, Baltimore, Md.
Summers Fertilizer Co. (Inc.), Stock Exchange Building, Baltimore, Md.
Swift & Co., Union Stock Yards, Chicago, Ill.
Talladega Fertilizer Manufacturing Co., Talladega, Ala.
Tennessee Chemical Co., Nashville, Tenn.
I. P. Thomas & Son Co., Drexel Building, Philadelphia, Pa.
F. W. Tunnell & Co. (Inc.), 15 North Fifth Street, Philadelphia, Pa.
United States Phosphoric Products Corporation, Tampa, Fla.
Virginia-Carolina Chemical Corporation, 11 South Twelfth Street, Richmond, Va.
Welch Chemical Co., Columbus, Ohio.
Wilson & Toomer Fertilizer Co., 772 West Bay Street, Jacksonville, Fla.
Wuichet Fertilizer Co., Dayton, Ohio.
Wulbern Fertilizer Co., Charleston, S. C.
York Chemical Works, York, Pa.

Consumers of phosphate rock for the manufacture of dicalcium phosphate fertilizers

Myles Salt Co. (Ltd.), 1007 Camp Street, New Orleans, La.

Consumers of phosphate rock for the manufacture of ferrophosphorus

Ohio Ferro-Alloys Corporation, Canton, Ohio.
Oldbury Electro-Chemical Co., Niagara Falls, N. Y.
Southern Manganese Corporation, Birmingham, Ala.
Tennessee Products Corporation, Nashville, Tenn.
Victor Chemical Works, 343 South Dearborn Street, Chicago, Ill.
Warner Iron Co., Nashville, Tenn.

Consumers of phosphate rock for the manufacture of phosphoric acid

Anaconda Copper Mining Co., Anaconda, Mont.
Bowker Chemical Co., 419 Fourth Avenue, New York, N. Y.
Federal Phosphorus Co., Birmingham, Ala.
International Agricultural Corporation, 61 Broadway, New York, N. Y.
Phosphate Products Corporation, Richmond Trust Building, Richmond, Va.
Provident Chemical Works, Planters Building, St. Louis, Mo.
Rumford Chemical Works, Rumford, R. I.
Victor Chemical Works, 343 South Dearborn Street, Chicago, Ill.
Virginia-Carolina Chemical Corporation, 11 South Twelfth Street, Richmond, Va.
Warner Chemical Co., 415 Lexington Avenue, New York, N. Y.
Wilckes-Martin-Wilckes Co., 135 William Street, New York, N. Y.

Consumers of phosphate rock for the manufacture of phosphorus

Oldbury Electro-Chemical Co., Niagara Falls, N. Y.

Consumers of phosphate rock for the manufacture of stock and poultry feed

Moorman Manufacturing Co., Quincy, Ill.
Myles Salt Co. (Ltd.), 1007 Camp Street, New Orleans, La.
Vitamineral Products Co., Peoria, Ill.

Iron and steel companies using phosphate rock occasionally or as standard practice

Alan Wood Iron & Steel Co., Widener Building, Philadelphia, Pa.
American Rolling Mill Co., Middletown, Ohio.
Antrim Iron Co., Grand Rapids, Mich.
Bethlehem Steel Co., Bethlehem, Pa.

E. & G. Brooke Iron Co., Birdsboro, Pa.
Cleveland-Cliffs Iron Co., 1460 Union Trust Building, Cleveland, Ohio.
Colonial Iron Co., 149 Broadway, New York, N. Y.
Columbia Steel Corporation, 215 Market Street, San Francisco, Calif.
Corrigan, McKinney Steel Co., 3100 East Forty-fifth Street, Cleveland, Ohio.
Delaware River Steel Co., Chester, Pa.
Delta Chemical & Iron Co., Wells, Mich.
Hamilton Coke & Iron Co., Hamilton, Ohio.
Hanna Furnace Co., 1300 Leader Building, Cleveland, Ohio.
Inland Steel Co., 38 South Dearborn Street, Chicago, Ill.
International Harvester Co., 606 South Michigan Avenue, Chicago, Ill.
Jackson Iron & Steel Co., Jackson, Ohio.
Marting Iron & Steel Co., Ironton, Ohio.
Perry Iron Co., Union Trust Building, Cleveland, Ohio.
Pulaski Iron Co., Pulaski, Va.
Reliance Coke & Furnace Co., 514 Frick Building, Pittsburgh, Pa.
St. Louis Gas & Coke Corporation, Box 364, Granite City, Ill.
Shenango Furnace Co., Oliver Building, Pittsburgh, Pa.
Sloss-Sheffield Steel & Iron Co., Birmingham, Ala.
Superior Steel & Malleable Castings Co., Benton Harbor, Mich.
Toledo Furnace Co., Union Trust Building, Cleveland, Ohio.
Warren Foundry & Pipe Corporation, Wharton, N. J.
Youngstown Sheet & Tube Co., Youngstown, Ohio.
Zenith Furnace Co., West Duluth, Minn.

Consumers of phosphate rock for the manufacture of phosphate chemicals

American Cyanamid Co., 535 Fifth Avenue, New York, N. Y. (monoammonium phosphate, disodium phosphate, and trisodium phosphate).

Anaconda Copper Mining Co., Anaconda, Mont. (ammonium phosphates).

Blockson Chemical Co., Joliet, Ill. (ammonium phosphate, disodium phosphate, and trisodium phosphate).

Bowker Chemical Co., 419 Fourth Avenue, New York, N. Y. (disodium phosphate and trisodium phosphate).

Calumet Chemical Co., Joliet, Ill. (monocalcium phosphate and dicalcium phosphate).

Federal Phosphorus Co., Birmingham, Ala. (monoammonium phosphate, diammonium phosphate, monosodium phosphate, disodium phosphate, trisodium phosphate, acid sodium phosphate, monocalcium phosphate, dicalcium phosphate, and tricalcium phosphate).

General Chemical Co., 40 Rector Street, New York, N. Y. (disodium phosphate and trisodium phosphate).

Grasselli Chemical Co., Guardian Building, Cleveland, Ohio (disodium phosphate and trisodium phosphate).

International Agricultural Corporation, 61 Broadway, New York, N. Y. (ammonium phosphate, disodium phosphate, and trisodium phosphate).

Phosphate Products Corporation, Richmond Trust Building, Richmond, Va. (ammonium phosphate, calcium acid phosphate, and sodium phosphate).

Provident Chemical Works, Planters Building, St. Louis, Mo. (monocalcium phosphate, dicalcium phosphate, tricalcium phosphate, acid calcium phosphate, pyrocalcium phosphate, pyrosodium phosphate, and trisodium phosphate).

Rumford Chemical Works, Rumford, R. I. (monocalcium phosphate, dicalcium phosphate, and tricalcium phosphate).

Victor Chemical Works, 343 South Dearborn Street, Chicago, Ill. (monoammonium phosphate, diammonium phosphate, monocalcium phosphate, dicalcium phosphate, tricalcium phosphate, monosodium phosphate, disodium phosphate, trisodium phosphate, and acid pyrosodium phosphate).

Virginia-Carolina Chemical Corporation, 11 South Twelfth Street, Richmond, Va. (monocalcium phosphate).

Warner Chemical Co., 415 Lexington Avenue, New York, N. Y. (monosodium phosphate, disodium phosphate, and trisodium phosphate).

Wilckes-Martin-Wilckes Co., 135 William Street, New York, N. Y. (monoammonium phosphate, diammonium phosphate, sodium ammonium phosphate, monocalcium phosphate, dicalcium phosphate, tricalcium phosphate, and potassium phosphate).

WORLD PRODUCTION

On the basis of reports covering 95 per cent of the tonnage the world production of phosphate rock in 1928 is estimated at about 10,000,000 metric tons. This is about 500,000 tons less than in 1927 but still is higher than for any other previous year. Decreases in the production of several countries—notably Tunisia, Algeria, Nauru and Ocean Islands, and Egypt—were not quite offset by increased shipments in the United States and French Morocco. The largest increase in production was in the United States, about 336,015 metric tons. Tunisia suffered the greatest decline, 286,000 tons.

France and its colonies, United States, and the British Empire produced more than 90 per cent of the world's production of phosphate rock in 1928. France and its colonies again led all other nations in phosphate rock production, producing about 50 per cent of the total world production in 1928, as against a little more in 1927. The United States produced about 35 per cent in 1928 as against about 30 per cent in 1927, and the British Empire about 6 per cent as against about 7 per cent in the previous year. No other nation produced over 2 per cent of the world total.

The French North African Colonies had a net decrease in 1928 from 1927, due to the decreased production in Tunisia and Algeria. As compared with 1927, Tunisian production fell off slightly more than 9 per cent and Algerian 5 per cent. The remaining French North African colony, French Morocco, continued the rise that began in 1921 and shipments showed an increase of about 139,000 tons over 1927.

Of the individual countries in 1928 the United States was still the leading producer, with 3,557,604 metric tons, exceeding Tunisia, second in output, by 768,604 tons, a much wider margin than in 1927, because of the increased production in the United States and the decline in Tunisian production. French Morocco retained third place, which it had taken from Algeria in 1927, with a marketed production of 1,337,079 metric tons. Algeria remained in fourth place, with Nauru and Ocean Islands fifth.

The second, third, and fourth largest phosphate rock producing fields in the world are in French possessions, in Tunisia, Morocco, and Algeria, respectively. The first and fifth places belong to fields in the United States, in Florida and Tennessee, respectively. The largest producing area is the Florida land-pebble phosphate rock area. This field, which for many years was the leader, was surpassed in 1927 by the Tunisian field but regained its supremacy in 1928 and had a lead of about 43,000 metric tons.

World production of phosphate rock, 1924-1928, by countries, in metric tons

[Compiled under supervision of L. M. Jones, of the Bureau of Mines]

Country	1924	1925	1926	1927	1928
Algeria	681,136	815,116	929,355	919,108	875,947
Angaur Island [1]	61,000	61,000	61,000	61,000	61,000
Australia:					
New South Wales	109	203	257	132	138
South Australia	85	754	896	761	----------
Victoria	541	----------	122	----------	----------
Belgium	26,250	15,125	30,030	39,760	(2)
Canada	----------	[3] 15	[3] 36	137	582
Christmas Island (Straits Settlements) [4]	127,166	111,835	131,057	118,553	(2)
Egypt	87,869	106,778	232,008	279,389	200,563
Estonia	----------	2,044	4,054	3,576	1,772
France	206,859	230,496	252,168	(2)	(2)
Germany: [3]					
Bavaria	1,000	200	----------	----------	----------
Prussia	399	123	542	443	----------
Gilbert and Ellice Islands [5]	192,516	(2)	(2)	(2)	(2)
India (British)	6,529	1,504	730	613	818
Indo-China	12,461	30,236	14,511	20,700	19,629
Japan	85,617	87,375	108,569	75,386	58,776
Madagascar	[4] 749	449	6,135	6,480	8,450
Makatea Island [4]	89,611	81,061	127,177	135,666	136,306
Morocco, French	461,582	692,181	882,821	1,400,000	[6] 1,337,079
Nauru and Ocean Islands [5]	459,162	478,278	398,059	633,345	509,970
Netherland West Indies: Curaçao [4]	100,471	81,771	106,807	108,881	104,194
New Caledonia	[4] 8,169	12,000	[4] 10,647	9,000	7,000
New Zealand	1,600	----------	----------	----------	----------
Norway [3]	345	467	343	----------	----------
Philippine Islands	6,528	7,528	7,512	705	1,354
Russia [7]	28,380	39,824	72,516	56,460	(2)
Seychelles Islands [4]	----------	3,259	3,259	11,511	(2)
Spain	6,746	5,315	5,656	4,202	7,897
Tunisia	2,391,000	2,691,000	2,568,000	3,075,000	2,789,000
United States	2,913,817	3,537,702	3,261,496	3,221,589	3,557,604

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[1] Approximate production. (Imp. Inst. London).
[2] Data not available.
[3] Apatite.
[4] Exports.
[5] Exports during fiscal year ended June 30 of the year stated.
[6] Shipments, of which 1,323,293 tons represent exports.
[7] Year ended Sept. 30.

SAND AND GRAVEL[1]

By Estelle R. Phillips[2]

PRODUCTION

The sand and gravel reported as sold or used by producers in the United States in 1928 amounted to 209,118,868 short tons, valued at $119,207,937, an increase of 6 per cent in quantity and 3 per cent in value as compared with 1927. A very thorough canvass of the whole country slightly increased the number of companies reporting for 1928 over the number for 1927. This in part accounts for the general increase shown. There were increases in the quantity and value of glass sand, molding sand, building sand, and filter sand, and in building and paving gravel. There was a decrease of 1 per cent in quantity of paving sand reported and there were decreases in quantity and value of grinding and polishing sand, fire or furnace sand, engine sand, railroad ballast sand, and railroad ballast gravel.

The total quantity of sand in 1928 amounted to 97,737,717 short tons and was valued at $56,132,406, an increase of 4 per cent in quantity and 3 per cent in value as compared with 1927. The total gravel in 1928 amounted to 111,381,151 short tons, valued at $63,075,531, an increase of 7 per cent in quantity and 3 per cent in value as compared with 1927.

Seven States exceeded 11,000,000 tons each in production in 1928; New York led, with 21,109,864 tons, and Illinois, California, Michigan, Ohio, Pennsylvania, and Indiana followed in order. Each of these States exceeded $5,300,000 in total value of output; New York led, with a value of $12,572,634, and Pennsylvania, Illinois, Ohio, California, Michigan, and Indiana followed in order.

The total production of washed and screened sand and gravel reported for 1928 amounted to 160,463,754 short tons, valued at $98,314,122. This quantity is 77 per cent of the total sand and gravel produced. The washed and screened material has amounted to 76 or 77 per cent of the total production in each of the past three years.

The total output of sand and gravel in 1928 was the product of approximately 2,600 plants and pits. The State highway departments and railroads do not always indicate separately in their reports the locations from which they produce their sand and gravel, so that the number of plants and pits is in this respect somewhat below the actual figure. Each of 10 States reported production from more than 100 plants and pits, in order as follows: Illinois, New York, Pennsylvania, Ohio, Michigan, California, Indiana, Wisconsin, New Jersey, and Minnesota.

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[1] Work on manuscript completed December, 1929.

[2] Figures on imports and exports compiled by J. A. Dorsey, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.

Sand and gravel sold or used by producers in the United States, 1919–1928

Year	Sand		Gravel (including railroad ballast)		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1919	35, 969, 736	$26, 389, 679	34, 606, 671	$19, 561, 877	70, 576, 407	$45, 951, 556
1920	43, 776, 142	39, 198, 614	38, 265, 246	26, 462, 991	82, 041, 388	65, 661, 605
1921	38, 294, 954	29, 049, 950	41, 550, 054	27, 434, 295	79, 845, 008	56, 484, 245
1922	49, 694, 923	35, 469, 920	45, 172, 123	29, 147, 744	94, 867, 046	64, 617, 664
1923	67, 365, 271	48, 473, 565	72, 566, 882	42, 430, 089	139, 932, 153	90, 903, 654
1924	75, 572, 010	48, 844, 465	80, 658, 053	48, 168, 650	156, 230, 063	97, 013, 115
1925	87, 182, 222	55, 148, 325	84, 819, 251	52, 393, 798	172, 001, 473	107, 542, 123
1926	92, 114, 279	55, 675, 988	90, 986, 539	55, 662, 713	183, 100, 818	111, 338, 701
1927	93, 588, 339	54, 291, 398	103, 865, 930	61, 238, 388	197, 454, 269	115, 529, 786
1928	97, 737, 717	56, 132, 406	111, 381, 151	63, 075, 531	209, 118, 868	119, 207, 937

Sand and gravel sold or used by producers in the United States, 1927 and 1928, by uses

Use	1927		1928	
	Short tons	Value	Short tons	Value
Sand:				
Glass	2, 171, 693	$3, 257, 790	2, 310, 828	$3, 435, 645
Molding	4, 194, 975	4, 458, 508	4, 781, 765	5, 089, 969
Building	40, 737, 377	22, 198, 767	45, 629, 207	24, 116, 772
Paving	35, 606, 622	17, 767, 491	35, 244, 544	17, 305, 750
Grinding and polishing	1, 686, 762	2, 193, 690	1, 538, 046	1, 991, 962
Fire or furnace	410, 801	452, 835	305, 659	362, 044
Engine	2, 618, 890	1, 640, 736	2, 413, 043	1, 544, 204
Filter	74, 674	155, 137	113, 978	226, 896
Other [1]	6, 086, 545	2, 166, 444	5, 400, 647	2, 059, 164
	93, 588, 339	54, 291, 398	97, 737, 717	56, 132, 406
Gravel:				
Building	30, 432, 031	21, 947, 666	34, 747, 235	24, 071, 208
Paving	44, 891, 975	29, 887, 365	49, 088, 786	30, 697, 993
Railroad ballast [2]	28, 541, 924	9, 403, 357	27, 545, 130	8, 306, 330
	103, 865, 930	61, 238, 388	111, 381, 151	63, 075, 531
Grand total	197, 454, 269	115, 529, 786	209, 118, 868	119, 207, 937

[1] Includes some sand used for railroad ballast, fills, etc.

[2] Includes some gravel used by the railroads for fills and other purposes.

Sand and gravel sold or used by producers in the United States in 1927, by States and uses

State	Glass sand		Molding sand		Building sand		Paving sand		Grinding and polishing sand		Fire or furnace sand		Engine sand	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Alabama			(1)	(1)	338, 684	$123, 781	341, 789	$187, 465						
Arizona					(1)	(1)								
Arkansas	(1)	(1)	(1)	(1)	167, 300	82, 775	141, 724	81, 859	(1)	(1)	(1)	(1)	(1)	(1)
California	6, 882	$21, 917	44, 756	$66, 348	3, 475, 946	1, 876, 361	2, 533, 751	1, 162, 668	17, 837	$30, 569	34, 201	$43, 497	280, 263	$112, 173
Colorado			(1)	(1)	181, 294	132, 983	124, 145	102, 325			(1)	(1)	21, 328	14, 541
Connecticut			1, 435	1, 637	385, 536	216, 690	86, 579	61, 211	(1)	(1)				
Delaware			7, 300	5, 650	20, 891	18, 622	23, 700	11, 850	300	900	100	75	6, 000	2, 100
District of Columbia					492, 911	418, 974	67, 215	57, 133					1, 440	1, 224
Florida					791, 046	366, 124	349, 045	170, 784					4, 398	2, 377
Georgia	3, 000	3, 000	30, 000	6, 000	228, 800	92, 275	306, 625	141, 174	17, 340	8, 670	25, 000	5, 000	15, 455	3, 013
Hawaii														
Idaho					(1)	(1)							120	93
Illinois	629, 268	356, 333	652, 955	455, 913	4, 194, 993	1, 954, 694	2, 798, 414	1, 124, 956	362, 804	692, 984	(1)	(1)	129, 814	65, 196
Indiana	(1)	(1)	309, 305	172, 816	1, 688, 479	614, 630	1, 987, 573	827, 435	(1)	(1)	(1)	(1)	150, 693	42, 789
Iowa			14, 522	11, 231	583, 339	268, 056	802, 974	292, 504	(1)	(1)	(1)	(1)	34, 171	18, 102
Kansas			(1)	(1)	894, 966	625, 639	741, 833	445, 059					132, 571	89, 128
Kentucky			22, 268	34, 627	662, 048	439, 622	285, 845	188, 781	(1)	(1)	(1)	(1)	25, 611	15, 676
Louisiana					367, 237	202, 981	158, 943	77, 863					27, 194	12, 529
Maine					(1)	(1)	12, 600	8, 643					(1)	(1)
Maryland	(1)	(1)	(1)	(1)	274, 379	165, 591	1, 360, 714	732, 748	(1)	(1)			(1)	(1)
Massachusetts	940	5, 511	41, 151	40, 306	1. 092, 292	877, 179	168, 580	135, 792	7, 308	14, 160	(1)	(1)	29, 190	32, 623
Michigan	(1)	(1)	514, 616	218, 625	1, 690, 481	630, 690	3, 295, 012	1, 234. 837	175, 428	31, 620			4, 004	1, 077
Minnesota			14, 432	12, 182	716, 173	292, 238	561, 182	273, 469	2, 610	5, 428			59, 757	19, 589
Mississippi					126, 356	67, 978	149, 417	65, 024					(1)	(1)
Missouri	99, 026	144, 259	96, 961	66, 239	852, 775	553, 902	672, 383	411, 159	(1)	(1)	(1)	(1)	26, 439	17, 606
Montana					19, 935	16, 556	68, 994	66, 907					(1)	(1)
Nebraska			(1)	(1)	664. 032	300, 652	113, 188	44, 585					39, 190	10, 506
Nevada							(1)	(1)						
New Hampshire					57, 784	23, 114	194, 010	98, 375					12, 700	2, 920
New Jersey	185, 568	278, 588	444, 667	564, 826	1, 512, 150	788, 626	1, 303, 523	704, 700	70, 961	203, 897	57, 428	84, 316	87, 529	36, 615
New Mexico			100	100	(1)	(1)	27, 000	27, 000	300	450			8, 000	8, 000
New York	(1)	(1)	608, 099	1, 028, 197	5, 982, 517	2, 942, 487	6, 099, 503	2, 758, 788	(1)	(1)	(1)	(1)	119, 036	65, 675
North Carolina					258, 086	78, 891	416, 383	125, 639					34, 637	16, 897
North Dakota					21, 691	14, 915	(1)	(1)						
Ohio	(1)	(1)	738, 782	1, 005, 321	2, 813, 682	1, 781, 198	2, 347, 942	1, 543, 486	(1)	(1)	81, 101	160, 054	61, 422	38, 482
Oklahoma	30, 107	52, 787			355, 774	217, 254	603, 491	343, 100	(1)	(1)			(1)	(1)
Oregon					434, 355	273, 067	208, 438	130, 105					(1)	(1)
Pennsylvania	423, 895	814, 013	448, 586	551, 625	4, 385, 810	3, 436, 976	2, 594, 240	2, 001, 530	617, 591	730, 431	42, 910	53, 834	360, 935	429, 858

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[1] Included under "Undistributed."

Sand and gravel sold or used by producers in the United States in 1927, by States and uses—Continued

State	Glass sand		Molding sand		Building sand		Paving sand		Grinding and polishing sand		Fire or furnace sand		Engine sand	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Rhode Island	----------	----------	(1)	(1)	(1)	(1)	3, 720	$4, 600	----------	----------	----------	----------	----------	----------
South Carolina	----------	----------	----------	----------	62, 974	$30, 411	438, 387	145, 548	----------	----------	----------	----------	28, 150	$6, 982
South Dakota	----------	----------	----------	----------	72, 488	43, 213	73, 683	11, 785	----------	----------	----------	----------	4, 775	2, 032
Tennessee	----------	----------	4, 041	$2, 962	546, 543	389, 487	480, 116	355, 597	(1)	(1)	866	$773	8, 629	8, 605
Texas	8, 706	$6, 073	461	654	914, 307	435, 851	1, 039, 317	403, 922	343	$520	----------	----------	103, 381	42, 767
Utah	----------	----------	(1)	(1)	35, 650	12, 800	49, 516	28, 496	(1)	(1)	----------	----------	24, 300	14, 580
Vermont	----------	----------	1, 413	350	9, 585	6, 514	(1)	(1)	(1)	(1)	----------	----------	(1)	(1)
Virginia	34, 878	91, 947	17, 151	29, 159	289, 837	225, 030	300, 102	212, 595	13, 203	18, 289	(1)	(1)	149, 487	72, 428
Washington	----------	----------	(1)	(1)	551, 113	249, 983	269, 320	118, 832	----------	----------	----------	----------	110, 581	32, 418
West Virginia	509, 905	1, 100, 413	(1)	(1)	206, 175	228, 729	497, 777	433, 016	(1)	(1)	11, 496	9, 730	272, 930	245, 892
Wisconsin	----------	----------	97, 934	71, 346	2, 211, 041	604, 731	1, 467, 949	385, 285	(1)	(1)	(1)	(1)	70, 656	20, 644
Wyoming	----------	----------	----------	----------	32, 652	28, 715	100	25	----------	----------	----------	----------	----------	----------
Undistributed [2]	239, 518	382, 949	84, 040	112, 394	73, 270	47, 782	39, 880	28, 836	400, 737	455, 772	157, 699	95, 556	174, 104	135, 599
	2, 171, 693	3, 257, 790	4, 194, 975	4, 458, 508	40, 737, 377	22, 198, 767	35, 606, 622	17, 767, 491	1, 686, 762	2, 193, 690	410, 801	452, 835	2, 618, 890	1, 640, 736
Average value	----------	1. 50	----------	1. 06	----------	0. 54	----------	0. 50	----------	1. 30	----------	1. 10	----------	0. 63

[1] Included under "Undistributed."

[2] Includes items entered as "(1)."

Sand and gravel sold or used by producers in the United States in 1927, by States and uses—Continued

State	Filter sand		Other sands		Building gravel		Paving gravel		Railroad ballast gravel		Total	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Alabama					190, 873	$115, 236	612, 996	$612, 524	(1)	(1)	2, 085, 696	$1, 292, 233
Arizona					(1)	(1)			91, 771	$44, 990	92, 956	46, 363
Arkansas			(1)	(1)	50, 512	44, 676	281, 493	161, 575	721, 108	351, 646	1, 461, 693	832, 520
California	1, 467	$4, 784	925, 391	$279, 934	2, 759, 637	1, 978, 212	2, 460, 072	1, 771, 086	1, 719, 925	697, 708	14, 260, 128	8, 045, 257
Colorado					173, 105	124, 347	103, 357	81, 172	(1)	(1)	622, 204	465, 818
Connecticut			(1)	(1)	129, 504	130, 578	62, 389	64, 979			667, 983	485, 169
Delaware	1, 625	1, 250			1, 261	1, 891					61, 177	42, 338
District of Columbia					364, 957	485, 393	64, 404	85, 657			990, 927	1, 048, 381
Florida					352, 865	317, 635	60, 028	68, 845	31, 525	4, 739	1, 588, 907	930, 504
Georgia	(1)	(1)	(1)	(1)	11, 860	12, 977	32, 461	19, 881	(1)	(1)	683, 366	295, 505
Hawaii							8, 505	25, 515			8, 505	25, 515
Idaho					(1)	(1)	69, 197	47, 313	(1)	(1)	198, 091	81, 238
Illinois	(1)	(1)	2, 503, 326	1, 067, 147	2, 598, 191	1, 237, 709	3, 324, 405	1, 535, 623	2, 108, 917	652, 499	19, 328, 703	9, 166, 934
Indiana			428, 861	118, 554	1, 191, 698	595, 749	3, 108, 915	2, 001, 923	2, 907, 592	1, 144, 297	11, 870, 658	5, 552, 804
Iowa	13, 378	17, 714	33, 205	12, 186	362, 512	338, 950	1, 793, 420	725, 986	328, 829	129, 790	3, 981, 143	1, 839, 176
Kansas	(1)	(1)	14, 002	4, 689	157, 332	100, 274	242, 166	170, 314	(1)	(1)	2, 254, 648	1, 456, 130
Kentucky			(1)	(1)	776, 206	472, 627	658, 030	402, 604	519, 025	130, 474	3, 002, 311	1, 718, 055
Louisiana					568, 541	459, 439	1, 012, 890	801, 607	588, 307	355, 645	2, 723, 112	1, 910, 064
Maine			(1)	(1)	86, 780	116, 387	24, 328	17, 524	(1)	(1)	584, 395	251, 448
Maryland			1, 698	1, 486	185, 479	166, 164	(1)	(1)	1, 094	361	2, 914, 448	2, 185, 248
Massachusetts	3, 051	8, 164	(1)	(1)	586, 373	754, 237	707, 215	616, 561	1, 301	1, 479	2, 646, 335	2, 495, 696
Michigan			(1)	(1)	2, 755, 945	1, 836, 424	4, 971, 393	3, 083, 211	1, 132, 101	425, 959	15, 419, 499	7, 800, 541
Minnesota	1, 035	3, 105	41, 973	16, 992	623, 034	631, 046	628, 473	629, 544	866, 885	288, 032	3, 515, 554	2. 171, 625
Mississippi			(1)	(1)	151, 806	96, 473	1, 344, 092	658, 203	1, 266, 025	460, 549	3, 122, 401	1, 372, 089
Missouri			(1)	(1)	1, 207, 632	754, 441	845, 819	550, 980	815, 793	207, 349	4, 829, 473	2, 875, 530
Montana			(1)	(1)	33, 843	22, 356	421, 915	468, 466	1, 504, 334	310, 669	2, 187, 934	910, 513
Nebraska			(1)	(1)	629, 561	431, 805	872, 453	551, 687	41, 254	16, 459	2, 420, 364	1, 370, 605
Nevada			(1)	(1)			(1)	(1)	378, 836	126, 265	462, 574	187, 150
New Hampshire							543, 124	486, 805	56, 000	42, 000	863, 618	653, 214
New Jersey	29, 208	82, 048	29, 109	39, 756	270, 421	267, 212	587, 509	487, 111	49, 086	64, 594	4, 627, 159	3, 602, 289
New Mexico	80	120			(1)	(1)	31, 036	31, 036	(1)	(1)	360, 020	226. 990
New York	12, 145	3, 816	29, 392	21, 609	3, 914, 189	3, 172, 939	2, 699, 462	1, 951, 884	410, 652	191, 022	19, 896, 766	12, 157, 612
North Carolina			6, 553	3, 275	247, 558	203, 770	456, 404	421, 698	43, 187	21, 246	1, 462, 808	871, 416
North Dakota					(1)	(1)	(1)	(1)	(1)	(1)	343, 820	134, 830
Ohio	(1)	(1)	107, 509	32, 386	2, 071, 035	1, 549, 503	2, 252, 534	1, 622, 426	2, 604, 724	1, 062, 333	13, 187, 415	9, 085, 413
Oklahoma			(1)	(1)	87, 049	60, 317	844, 030	616, 064	131, 654	27, 016	2, 074, 963	1, 331, 222
Oregon			(1)	(1)	593, 689	330, 718	973, 647	630, 692	(1)	(1)	2, 415, 069	1, 438, 798
Pennsylvania			14, 215	16, 733	2, 939, 220	2, 482, 095	1, 929, 954	1, 512, 380	74, 825	10, 931	13, 832, 181	12, 040, 406
Rhode Island					(1)	(1)	253, 509	273, 713			271, 065	303, 639

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[1] Included under "Undistributed."

Sand and gravel sold or used by producers in the United States in 1927, by States and uses—Continued

State	Filter sand		Other sands		Building gravel		Paving gravel		Railroad ballast gravel		Total	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
South Carolina	(1)	(1)	(1)	(1)			(1)	(1)	(1)	(1)	893, 772	$397, 781
South Dakota			8, 480	$1, 532	62, 783	$52, 141	614, 633	$56, 558	325, 981	$63, 957	1, 162, 823	231, 218
Tennessee			(1)	(1)	258, 707	217, 862	1, 005, 029	758, 197	(1)	(1)	2, 479, 249	1, 842, 144
Texas			213, 859	67, 277	1, 255, 709	1, 024, 294	2, 403, 645	1, 531, 704	3, 755, 424	1, 181, 072	9, 695, 152	4, 694, 134
Utah					4, 804	2, 756	(1)	(1)	570, 779	89, 625	903, 244	272, 609
Vermont			(1)	(1)	(1)	(1)	7, 950	7, 725	28, 775	10, 125	171, 250	39, 143
Virginia			(1)	(1)	200, 754	190, 886	354, 591	298, 776	(1)	(1)	1, 502, 248	1, 217, 450
Washington			(1)	(1)	787, 227	320, 943	965, 773	478, 399	1, 701, 605	359, 192	4, 423, 246	1, 570, 999
West Virginia					132, 235	126, 215	813, 171	655, 178	59, 805	30, 677	2, 522, 617	2, 879, 631
Wisconsin	(1)	(1)	325, 239	54, 308	1, 550, 462	622, 584	2, 628, 663	1, 271, 105	629, 348	100, 927	9, 020, 124	3, 190, 334
Wyoming					22, 406	23, 121	430, 400	344, 320	874, 917	97, 884	1, 360, 475	494, 065
Undistributed [2]	12, 685	$34, 136	1, 403, 733	428, 580	84, 276	75, 284	1, 386, 495	1, 298, 814	2, 200, 540	701, 846		
	74, 674	155, 137	[3] 6, 086, 545	[3] 2, 166, 444	30, 432, 031	21, 947, 666	44, 891, 975	29, 887, 365	[4] 28, 541, 924	[4] 9, 403, 357	197, 454, 269	115, 529, 786
Average value		2. 08		0. 36		0. 72		0. 67		0. 33		0. 59

[1] Included under "Undistributed."

[2] Includes items entered as "(1)."

[3] Includes 2,979,836 tons of sand, valued at $832,190, used for railroad ballast, and 1,026,748 tons of sand, valued at $182,767, used by the railroads for fills, bank widening, and stock-car bedding.

[4] Includes some gravel used by the railroads for fills and other purposes.

Sand and gravel sold or used by producers in the United States in 1928, by States and uses

State	Glass sand		Molding sand		Building sand		Paving sand		Grinding and polishing sand		Fire or furnace sand		Engine sand	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Alabama			(1)	(1)	558, 427	$174, 255	528, 827	$213, 555					(1)	(1)
Arizona					98, 175	90, 482	23, 640	22, 450					(1)	(1)
Arkansas	(1)	(1)	(1)	(1)	168, 191	110, 128	190, 720	132, 709	(1)	(1)	(1)	(1)	22, 407	$11, 781
California	(1)	(1)	67, 904	$100, 221	3, 973, 707	1, 955, 153	2, 631, 343	1, 152, 402	21, 145	$42, 701	22, 794	$29, 931	99, 115	36, 418
Colorado			(1)	(1)	234, 212	184, 521	71, 477	45, 785					27, 364	19, 650
Connecticut			438	1, 186	403, 585	275, 278	147, 992	86, 951	(1)	(1)				
Delaware			7, 960	4, 984	15, 607	12, 211	27, 800	15, 619	936	2, 340			7, 000	2, 400
District of Columbia					318, 696	175, 283	216, 065	118, 836					5, 402	2, 971
Florida					328, 256	154, 228	296, 613	135, 400					(1)	(1)
Georgia			3, 500	6, 500	185, 729	69, 193	450, 455	159, 232	15, 992	2, 566			2, 875	1, 857
Hawaii							3, 034	9, 102						
Idaho			(1)	(1)	6, 898	4, 934	10, 692	6, 437					(1)	(1)
Illinois	658, 036	$442, 923	698, 722	531, 468	4, 630, 189	2, 110, 951	3, 183, 271	1, 163, 281	399, 198	705, 895	31, 635	23, 406	128, 888	75, 131
Indiana	(1)	(1)	361, 740	202, 052	1, 928, 655	708, 998	1, 931, 304	913, 609	(1)	(1)	73, 380	29, 350	103, 220	37, 265
Iowa			64, 929	43, 667	531, 400	280, 843	1, 088, 377	450, 712	14, 087	31, 789			35, 608	17, 163
Kansas					1, 346, 266	783, 002	469, 556	242, 951					60, 121	30, 973
Kentucky			12, 684	22, 595	583, 588	568, 660	279, 434	164, 088			(1)	(1)	51, 974	32, 579
Louisiana					306, 291	166, 221	207, 391	78, 351					(1)	(1)
Maine					47, 150	48, 150	42, 872	27, 306	(1)	(1)			(1)	(1)
Maryland	(1)	(1)	(1)	(1)	465, 902	298, 051	924, 524	609, 617	(1)	(1)			(1)	(1)
Massachusetts	436	2, 451	35, 950	39, 591	1, 347, 309	1, 005, 498	178, 557	93, 642	5, 226	8, 433	(1)	(1)	38, 162	32, 996
Michigan	63, 546	145, 073	740, 428	323, 416	2, 258, 031	660, 966	3, 200, 533	1, 121, 334	(1)	(1)	(1)	(1)	(1)	(1)
Minnesota			19, 026	16, 924	741, 391	232, 971	537, 717	201, 248	(1)	(1)			50, 760	17, 257
Mississippi					232, 378	80, 514	112, 000	57, 325					1, 979	791
Missouri	145, 554	188, 960	95, 503	64, 814	1, 223, 547	722, 807	743, 642	490, 130	(1)	(1)			65, 010	47, 271
Montana					29, 347	18, 925	20, 618	19, 270					1, 994	218
Nebraska			1, 000	2, 000	545, 350	254, 506	119, 993	63, 103					29, 688	10, 229
Nevada	3, 585	7, 887	3, 104	9, 778			22, 829	18, 743						
New Hampshire							373, 222	97, 338					15, 000	3, 750
New Jersey	165, 142	246, 919	754, 581	998, 229	1, 340, 186	731, 551	1, 582, 954	774, 124	53, 736	155, 178	44, 824	57, 939	34, 139	13, 807
New Mexico					8, 721	6, 800	49, 629	22, 540	324	480			14, 832	11, 037
New York	(1)	(1)	550, 993	824, 429	8, 962, 122	4, 169, 686	4, 545, 193	2. 479, 199	(1)	(1)	(1)	(1)	142, 531	84, 395
North Carolina					329, 412	75, 330	127, 431	29, 985					53, 186	28, 110
North Dakota					34, 439	27, 776	3, 725	2, 525						
Ohio	63, 422	118, 570	782, 676	1, 094, 370	3, 009, 969	1, 810, 198	2, 455, 827	1, 459, 541	(1)	(1)	81, 160	154, 586	66, 762	50, 562
Oklahoma	(1)	(1)			341, 876	193, 865	638, 104	313, 829	200	100			23, 970	15, 771
Oregon					476, 737	324, 094	188, 600	121, 158					15, 437	6, 700

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[1] Included under "Undistributed."

Sand and gravel sold or used by producers in the United States in 1928, by States and uses—Continued

State	Glass sand		Molding sand		Building sand		Paving sand		Grinding and polishing sand		Fire or furnace sand		Engine sand	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Pennsylvania	451,014	$906,350	379,493	$561,217	3,900,967	$3,106,845	2,610,945	$1,913,302	448,859	$509,047	40,809	$54,476	353,582	$382,499
Rhode Island	------	------	(1)	(1)	4,935	753	(1)	(1)	------	------	------	------	------	------
South Carolina	------	------	------	------	59,353	26,672	(1)	(1)	------	------	------	------	------	------
South Dakota	------	------	------	------	44,117	26,245	76,461	42,823	------	------	------	------	(1)	(1)
Tennessee	------	------	9,105	7,682	699,719	487,958	465,279	285,117	32,534	30,377	------	------	72,718	45,907
Texas	------	------	6,700	20,000	943,144	638,827	1,061,482	583,952	5,155	5,725	------	------	91,656	44,443
Utah	------	------	------	------	26,931	15,845	48,362	26,688	------	------	------	------	(1)	(1)
Vermont	------	------	2,236	559	1,620	600	16,053	10,059	86,800	31,000	------	------	(1)	(1)
Virginia	35,060	75,945	23,433	33,202	226,336	130,326	354,819	129,058	17,934	23,256	(1)	(1)	124,282	58,963
Washington	------	------	1,236	4,389	661,777	299,266	484,665	239,847	------	------	------	------	40,662	10,624
West Virginia	527,063	1,068,017	(1)	(1)	325,258	301,468	348,056	322,204	(1)	(1)	(1)	(1)	267,207	235,508
Wisconsin	------	------	85,162	65,289	1,692,044	574,917	1,853,425	510,555	38,242	44,824	------	------	162,147	36,522
Wyoming	------	------	------	------	31,267	21,021	96,900	67,000	------	------	------	------	(1)	(1)
Undistributed [2]	197,970	232,550	73,262	111,407	------	------	202,136	61,718	397,678	398,251	11,057	12,356	203,365	138,656
	2,310,828	3,435,645	4,781,765	5,089,969	45,629,207	24,116,772	35,244,544	17,305,750	1,538,046	1,991,962	305,659	362,044	2,413,043	1,544,204
Average value	------	1.49	------	1.06	------	0.53	------	0.49	------	1.30	------	1.18	------	0.64

[1] Included under "Undistributed."

[2] Includes items entered as "(1)."

Sand and gravel sold or used by producers in the United States in 1928, by States and uses—Continued

State	Filter sand		Other sands		Building gravel		Paving gravel		Railroad ballast gravel		Total	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Alabama			(1)	(1)	686, 554	$458, 339	893, 537	$655, 640	(1)	(1)	3, 315, 985	$1, 719, 222
Arizona					(1)	(1)	(1)	(1)	(1)	(1)	566, 777	282, 996
Arkansas			(1)	(1)	37, 530	37, 498	586, 902	354, 544	533, 552	$246, 814	1, 683, 384	991, 408
California	5, 996	$11, 176	(1)	(1)	4, 035, 343	2, 619, 234	2, 984, 654	2, 079, 737	1, 449, 044	491, 755	15, 969, 132	8, 698, 884
Colorado			(1)	(1)	201, 812	153, 467	259, 435	189, 224	675	510	806, 051	605, 511
Connecticut			(1)	(1)	101, 130	102, 922			(1)	(1)	660, 708	479, 173
Delaware	5, 439	8, 025	2, 359	$2, 359	757	1, 136	757	1, 135			68, 615	50, 209
District of Columbia					277, 178	277, 178	184, 785	184, 785			1, 002, 126	759, 053
Florida					131, 074	95, 509	126, 521	107, 760	(1)	(1)	894, 879	495, 875
Georgia	108	648	39, 864	41, 573	18, 877	20, 887	27, 470	8, 035	78	78	744, 948	310, 569
Hawaii							536	1, 608			3, 570	10, 710
Idaho					22, 409	10, 753	395, 226	262, 854	(1)	(1)	716, 471	326, 278
Illinois	(1)	(1)	1, 814, 508	1, 022, 132	3, 182, 255	1, 573, 130	4, 475, 823	2, 069, 973	(1)	(1)	20, 969, 331	10, 243, 555
Indiana			(1)	(1)	1, 427, 388	942, 296	2, 657, 098	1, 599, 307	2, 211, 248	874, 303	11, 086, 331	5, 375, 058
Iowa	(1)	(1)	(1)	(1)	341, 533	333, 079	1, 013, 941	790, 344	234, 347	98, 928	3, 423, 619	2, 094, 955
Kansas			87, 097	34, 073	141, 404	62, 050	636, 830	373, 344	19, 003	6, 006	2, 760, 277	1, 532, 399
Kentucky	(1)	(1)	(1)	(1)	586, 652	489, 582	403, 137	258, 690	(1)	(1)	2, 100, 907	1, 589, 617
Louisiana			(1)	(1)	588, 935	516, 212	608, 495	386, 091	536, 940	328, 389	2, 310, 166	1, 503, 400
Maine	(1)	(1)			22, 152	34, 773	155, 866	90, 842	(1)	(1)	758, 528	348, 376
Maryland					221, 698	232, 689	908, 421	1, 123, 042			2, 602, 142	2, 409, 544
Massachusetts	4, 346	8, 058	(1)	(1)	912, 356	1, 035, 208	973, 639	671, 197	230, 614	68, 380	3, 751, 193	2, 986, 850
Michigan			655, 747	112, 431	1, 959, 106	1, 248, 623	4, 870, 352	2, 582, 543	1, 965, 579	605, 068	15, 893, 090	6, 828, 431
Minnesota	(1)	(1)	(1)	(1)	712, 897	454, 761	946, 692	700, 166	1, 254, 752	362, 985	4, 409, 245	2, 029, 091
Mississippi					231, 424	123, 113	1, 720, 706	884, 015	713, 804	282, 790	3, 012, 291	1, 428, 548
Missouri			(1)	(1)	1, 180, 406	764, 236	885, 691	671, 440	761, 198	194, 219	5, 251, 226	3, 248, 813
Montana	55	40	72, 579	18, 456	90, 516	72, 774	101, 694	96, 620	1, 114, 111	239, 072	1, 430, 914	465, 375
Nebraska	1, 960	1, 400	(1)	(1)	674, 186	405, 473	758, 871	495, 332	(1)	(1)	2, 234, 575	1, 265, 001
Nevada			18, 664	2, 052	(1)	(1)	28, 458	57, 736	(1)	(1)	201, 992	150, 966
New Hampshire					286, 402	58, 699	881, 997	798, 760	80, 000	60, 000	1, 636, 621	1, 018, 547
New Jersey	30, 039	87, 208	16, 373	15, 773	623, 938	608, 795	1, 619, 789	553, 241	26, 935	18, 626	6, 292, 636	4, 261, 390
New Mexico					883	1, 400	66, 383	53, 550	46, 467	15, 489	187, 239	111, 296
New York	21, 039	14, 903	51, 713	34, 447	4, 592, 179	3, 246, 724	1, 958, 857	1, 533, 211	268, 937	167, 830	21, 109, 864	12, 572, 634
North Carolina			(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	971, 746	531, 092
North Dakota					58, 585	53, 204	106, 882	8, 394	421, 069	43, 301	624, 700	135, 200
Ohio	5, 485	13, 411	(1)	(1)	1, 969, 289	1, 391, 571	2, 613, 940	1, 710, 854	2, 782, 619	1, 009, 515	14, 286, 169	9, 116, 356
Oklahoma			(1)	(1)	218, 617	149, 424	823, 033	612, 526	735, 998	71, 764	2, 827, 810	1, 426, 258
Oregon			(1)	(1)	717, 321	388, 439	690, 112	480, 977	(1)	(1)	2, 441, 945	1, 453, 070
Pennsylvania			29, 164	22, 118	2, 885, 858	2, 529, 239	1, 792, 826	1, 290, 846	62, 273	13, 887	12, 955, 790	11, 289, 826

[1] Included under "Undistributed."

Sand and gravel sold or used by producers in the United States in 1928, by States and uses—Continued

State	Filter sand		Other sands		Building gravel		Paving gravel		Railroad ballast gravel		Total	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Rhode Island			840	$150	(1)	(1)	159, 730	$17, 870	(1)	(1)	192, 862	$56, 610
South Carolina			(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	507, 716	341, 391
South Dakota			(1)	(1)	16, 485	$13, 570	2, 164, 054	1, 185, 782	148, 899	$29, 041	2, 461, 963	1, 301, 075
Tennessee			30, 984	24, 738	586, 088	506, 118	964, 732	728, 813	78, 382	40, 805	2, 939, 541	2, 157, 515
Texas	(1)	(1)	(1)	(1)	1, 434, 366	1, 100, 788	1, 823, 635	1, 278, 990	2, 470, 746	869, 425	8, 007, 392	4, 602, 421
Utah					101, 617	58, 534	375, 255	345, 475	(1)	(1)	1, 000, 131	544, 020
Vermont			(1)	(1)	(1)	(1)	39, 590	24, 789	(1)	(1)	295, 524	108, 461
Virginia			93, 801	43, 397	205, 380	203, 139	442, 264	342, 209	(1)	(1)	1, 602, 444	1, 081, 948
Washington	(1)	(1)	(1)	(1)	1, 091, 783	403, 821	1, 620, 528	693, 814	1, 973, 683	337, 077	5, 917, 748	2, 001, 195
West Virginia					307, 820	276, 195	449, 969	418, 383	119, 507	79, 725	2, 383, 659	2, 773, 341
Wisconsin	(1)	(1)	(1)	(1)	1, 420, 901	595, 429	3, 333, 963	1, 478, 742	1, 437, 579	339, 867	10, 104, 015	3, 680, 420
Wyoming			(1)	(1)	36, 930	37, 289	187, 500	120, 000	(1)	(1)	1, 742, 880	414, 004
Undistributed [2]	39, 511	$82, 027	2, 486, 954	685, 465	406, 221	383, 908	368, 210	324, 763	5, 867, 091	1, 410, 681		
	113, 978	226, 896	[3] 5, 400, 647	[3] 2, 059, 164	34, 747, 235	24, 071, 208	49, 088, 786	30, 697, 993	[4] 27, 545, 130	[4] 8, 306, 330	209, 118, 868	119, 207, 937
Average value		1.99		0.38		0.69		0.63		0.30		0.57

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[1] Included under "Undistributed."

[2] Includes items entered as "(1)."

[3] Includes 2,536,623 tons of sand, valued at $704,511, used as railroad ballast, and 758,570 tons of sand, valued at $139,971, used by the railroads for fills, bank widening, and stock-car bedding.

[4] Includes some gravel used by the railroads for fills and other purposes.

VALUES

The general trend in average value f. o. b. plant for the different classes of sand and gravel in 1928 was again slightly downward. The average value per ton for the total output was 57 cents in 1928, as compared with 59 cents in 1927 and 61 cents in 1926. The washed and screened sand and gravel, considered alone, averaged 61 cents a ton in 1928, as compared with 62 cents in 1927 and 64 cents in 1926. The average value of molding sand, grinding and polishing sand (including blast sand), and railroad ballast sand remained the same as in 1927. Glass sand, building sand, and paving sand each decreased 1 cent a ton in average value; filter sand decreased 9 cents; engine sand increased 1 cent; and fire or furnace sand increased 8 cents. Building gravel decreased 3 cents a ton, paving gravel 4 cents, and railroad ballast gravel 3 cents.

Average value per short ton of sand and gravel sold or used by producers in the United States, 1919–1928

[Based on amounts received for sales f. o. b. pits or nearest shipping points]

Kind	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928
Glass sand	$1. 97	$2. 19	$1. 81	$1. 62	$1. 84	$1. 71	$1. 64	$1. 59	$1. 50	$1. 49
Molding sand	1. 10	1. 46	1. 29	1. 17	1. 21	1. 13	1. 08	1. 06	1. 06	1. 06
Building sand	. 56	. 68	. 65	. 60	. 61	. 57	. 58	. 55	. 54	. 53
Paving sand	. 66	. 68	. 63	. 61	. 59	. 56	. 55	. 54	. 50	. 49
Grinding and polishing sand	1. 34	1. 80	1. 61	1. 46	1. 62	1. 54	1. 38	1. 35	1. 30	1. 30
Fire or furnace sand	1. 23	1. 81	1. 56	1. 42	1. 45	1. 23	1. 14	1. 06	1. 10	1. 18
Engine sand	. 77	. 82	. 86	. 76	. 76	. 66	. 62	. 61	. 63	. 64
Filter sand	1. 48	1. 27	1. 11	1. 99	1. 20	2. 01	2. 34	2. 13	2. 08	1. 99
Railroad ballast gravel	. 30	. 32	. 33	. 36	. 29	. 31	. 33	. 34	. 33	. 30
Gravel (exclusive of railroad ballast)	. 66	. 81	. 75	. 72	. 72	. 70	. 70	. 70	. 69	. 65
All sand and gravel	. 65	. 80	. 71	. 68	. 65	. 62	. 63	. 61	. 59	. 57

GEOGRAPHIC DISTRIBUTION OF SAND AND GRAVEL PRODUCTION

The following table has been compiled for comparing sand and gravel production in major geographic divisions of continental United States. The divisions are the Eastern, Central, Southern, and Western, and comprise the following States.

Eastern	Central	Southern	Western
Connecticut.	Illinois.	Alabama.	Arizona.
Delaware.	Indiana.	Arkansas.	California.
District of Columbia.	Iowa.	Florida.	Colorado.
Maine.	Kansas.	Georgia.	Idaho.
Maryland.	Kentucky.	Louisiana.	Montana.
Massachusetts.	Michigan.	Mississippi.	Nevada.
New Hampshire.	Minnesota.	North Carolina.	New Mexico.
New Jersey.	Missouri.	Oklahoma.	Oregon.
New York.	Nebraska.	South Carolina.	Utah.
Pennsylvania.	North Dakota.	Tennessee.	Washington.
Rhode Island.	Ohio.	Texas.	Wyoming.
Vermont.	South Dakota.	Virginia.	
West Virginia.	Wisconsin.		

Sand and gravel produced in continental United States, 1927 and 1928, by regions

Region	Concrete, road metal, and railroad ballast									
	1927				1928					
	Short tons	Value f. o. b. plant		Per cent of regional total, quantity	Per cent of regional total, quantity	Short tons	Value f. o. b. plant		Per cent change	
		Total	Average				Total	Average	Quantity	Value
Eastern States:										
Sand	26, 893, 886	$16, 168, 730	$0. 60	84. 9	85. 5	28, 164, 218	$16, 676, 206	$0. 59	+4. 7	+3. 1
Gravel	17, 977, 866	15, 061, 108	. 84	97. 9	99. 0	20, 560, 383	15, 640, 270	. 76	+14. 4	+3. 8
Total	44, 871, 752	31, 229, 838	. 70	89. 7	90. 7	48, 724, 601	32, 316, 476	. 66	+8. 6	+3. 5
Central States:										
Sand	33, 967, 248	15, 362, 393	. 45	81. 3	81. 7	35, 844, 694	15, 944, 375	. 44	+5. 5	+3. 8
Gravel	48, 338, 303	25, 488, 163	. 53	99. 5	98. 3	50, 900, 418	26, 191, 973	. 51	+5. 3	+2. 8
Total	82, 305, 551	40, 850, 556	. 50	91. 1	90. 7	86, 745, 112	42, 136, 348	. 49	+5. 4	+3. 1
Southern States:										
Sand	9, 488, 267	4, 739, 407	. 50	91. 4	91. 8	9, 623, 145	4, 722, 003	. 49	+1. 4	−. 4
Gravel	19, 359, 120	11, 587, 393	. 60	99. 8	99. 7	18, 277, 006	11, 175, 205	. 61	−5. 6	−3. 6
Total	28, 847, 387	16, 326, 800	. 57	96. 9	96. 8	27, 900, 151	15, 897, 208	. 57	−3. 3	−2. 6
Western States										
Sand	8, 974, 434	4, 527, 918	. 50	92. 0	93. 5	9, 775, 283	4, 775, 347	. 49	+8. 9	+5. 5
Gravel	16, 727, 678	8, 644, 984	. 52	95. 4	93. 8	19, 247, 730	9, 593, 016	. 50	+15. 1	+11. 0
Total	25, 702, 112	13, 172, 902	. 51	94. 2	93. 7	29, 023, 013	14, 368, 363	. 50	+12. 9	+9. 1
Continental United States:										
Total sand	79, 323, 835	40, 798, 448	. 51	84. 8	85. 3	83, 407, 340	42, 117, 931	. 50	+5. 1	+3. 2
Total gravel	102, 402, 967	60, 781, 648	. 59	98. 6	97. 8	108, 985, 537	62, 600, 464	. 57	+6. 4	+3. 0
Grand total	181, 726, 802	101, 580, 096	. 56	92. 0	92. 0	192, 392, 877	104, 718, 395	. 54	+5. 9	+3. 1

Region	Other uses							
	1927			1928				
	Short tons	Value f. o. b. plant		Short tons	Value f. o. b. plant		Per cent change	
		Total	Average		Total	Average	Quantity	Value
Eastern States:								
Sand	4, 785, 148	$6, 761, 217	$1. 41	4, 773, 177	$6, 734, 131	$1. 41	−0. 3	−0. 4
Gravel	393, 021	193, 159	. 49	212, 490	63, 407	. 30	−45. 9	−67. 2
Total	5, 178, 169	6, 954, 376	1. 34	4, 985, 667	6, 797, 538	1. 36	−3. 7	−2. 3
Central States:								
Sand	7, 801, 122	5, 669, 720	. 73	8, 005, 271	6, 134, 487	. 77	+2. 6	+8. 2
Gravel	229, 862	72, 919	. 32	855, 065	169, 136	. 20	+272. 0	+132. 0
Total	8, 030, 984	5, 742, 639	. 72	8, 860, 336	6, 303, 623	. 71	+10. 3	+9. 8
Southern States:								
Sand	896, 114	651, 577	. 73	864, 610	683, 453	. 79	−3. 5	+4. 9
Gravel	29, 866	8, 685	. 29	53, 541	8, 986	. 17	+79. 3	+3. 5
Total	925, 980	660, 262	. 71	918, 151	692, 439	. 75	−. 8	+4. 9
Western States:								
Sand	782, 120	410, 436	. 52	684, 285	453, 302	. 66	−12. 5	+10. 4
Gravel	801, 709	156, 462	. 20	1, 273, 982	231, 930	. 18	+58. 9	+48. 2
Total	1, 583, 829	566, 898	. 36	1, 958, 267	685, 232	. 35	+23. 6	+20. 9
Continental United States:								
Total sand	14, 264, 504	13, 492, 950	. 95	14, 327, 343	14, 005, 373	. 98	+. 4	+3. 8
Total gravel	1, 454, 458	431, 225	. 30	2, 395, 078	473, 459	. 20	+64. 7	+9. 8
Grand total	15, 718, 962	13, 924, 175	. 89	16, 722, 421	14, 478, 832	. 87	+6. 4	+4. 0

Sand and gravel produced in continental United States, 1927 and 1928, by regions—Continued

Region	Total									
	1927				1928					
	Short tons	Value f. o. b. plant		Per cent of U. S. total, quantity	Per cent of U. S. total, quantity	Short tons	Value f. o. b. plant		Per cent change	
		Total	Average				Total	Average	Quantity	Value
Eastern States:										
Sand	31, 679, 034	$22, 929, 947	$0. 72	33. 9	33. 7	32, 937, 395	$23, 410, 337	$0. 71	+4. 0	+2. 1
Gravel	18, 370, 887	15, 254, 267	. 83	17. 7	18. 6	20, 772, 873	15, 703, 677	. 76	+13. 1	+2. 9
Total	50, 049, 921	38, 184, 214	. 76	25. 3	25. 7	53, 710, 268	39, 114, 014	. 73	+7. 3	+2. 4
Central States:										
Sand	41, 768, 370	21, 032, 113	. 50	44. 6	44. 9	43, 849, 965	22, 078, 862	. 50	+5. 0	+5. 0
Gravel	48, 568, 165	25, 561, 082	. 53	46. 7	46. 5	51, 755, 483	26, 361, 109	. 51	+6. 6	+3. 1
Total	90, 336, 535	46, 593, 195	. 52	45. 8	45. 7	95, 605, 448	48, 439, 971	. 51	+5. 8	+4. 0
Southern States:										
Sand	10, 384, 381	5, 390, 984	. 52	11. 1	10. 7	10, 487, 755	5, 405, 456	. 52	+1. 0	+. 3
Gravel	19, 388, 986	11, 596, 078	. 60	18. 7	16. 5	18, 330, 547	11, 184, 191	. 61	−5. 5	−3. 6
Total	29, 773, 367	16, 987, 062	. 57	15. 1	13. 8	28, 818, 302	16, 589, 647	. 58	−3. 2	−2. 3
Western States:										
Sand	9, 756, 554	4, 938, 354	. 51	10. 4	10. 7	10, 459, 568	5, 228, 649	. 50	+7. 2	+5. 9
Gravel	17, 529, 387	8, 801, 446	. 50	16. 9	18. 4	20, 521, 712	9, 824, 946	. 48	+17. 1	+11. 6
Total	27, 285, 941	13, 739, 800	. 50	13. 8	14. 8	30, 981, 280	15, 053, 595	. 49	+13. 5	+9. 6
Continental United States:										
Total sand	93, 588, 339	54, 291, 398	. 58	100. 0	100. 0	97, 734, 683	56, 123, 304	. 57	+4. 4	+3. 4
Total gravel	103, 857, 425	61, 212, 873	. 59	100. 0	100. 0	111, 380, 615	63, 073, 923	. 57	+7. 2	+3. 0
Grand total	197, 445, 764	115, 504, 271	. 58	100. 0	100. 0	209, 115, 298	119, 197, 227	. 57	+5. 9	+3. 2

The table shows the relative importance of the production of sand and of gravel, although in some sections this relation is somewhat distorted, as the vagueness of the reports received from some of the producers necessitates estimates by the compilers.

Columns 4 and 5 show the percentages of sand and of gravel produced in the various regions for the common uses—concrete, road metal, and railroad ballast—as distinguished from other uses, such as special sands and gravels. There is little variation in the figures for the two years and, as the table shows, the common uses consume more than 90 per cent of the production except in the Eastern and Central States, where the production of special sands is relatively higher. Columns 9 and 10 record the percentage increase or decrease in quantity and value of the various items, and columns 3 and 8 show the average value per ton. It is interesting to note that a decrease in value per ton in 1928 compared with 1927 is generally coupled with an increase in quantity sold for the common uses, and vice versa. This relation is also true for "Other uses," as shown in columns 16 and 17, and for the total, as shown in columns 26 and 27. In columns 22 and 23 the relative importance of the four regions as sand and gravel producers is shown by the ratio of their tonnage to the country's total.

The ratio between sand production and gravel production is further indicated in the following table.

Ratio of sand production and of gravel production to total output, 1927 and 1928 in per cent of regional total

	Region									
	Eastern States		Central States		Southern States		Western States		Continental United States	
	1927	1928	1927	1928	1927	1928	1927	1928	1927	1928
For concrete, road metal, and railroad ballast:										
Sand	60	58	41	41	33	34	35	34	44	43
Gravel	40	42	59	59	67	66	65	66	56	57
For other uses:										
Sand	92	96	97	90	97	94	49	35	91	86
Gravel	8	4	3	10	3	6	51	65	9	14
Total production:										
Sand	63	61	46	46	35	36	36	34	47	47
Gravel	37	39	54	54	65	64	64	66	53	53

GLASS SAND

The production of glass sand in 1928 amounted to 2,310,828 short tons, valued at $3,435,645, an increase of 6 per cent in quantity and 5 per cent in value as compared with 1927. Glass sand was produced in 1928 in 16 States, of which the largest producers in order of quantity were Illinois, West Virginia, Pennsylvania, New Jersey, and Missouri; the output in these States ranged from 658,036 tons in Illinois to 145,554 tons in Missouri. West Virginia led in total value of glass sand produced with $1,068,017, and Pennsylvania, Illinois, New Jersey, and Missouri followed in order; the output of Missouri was valued at $188,960.

The average value per ton for the total output of glass sand was $1.49 in 1928, as compared with $1.50 in 1927 and $1.59 in 1926. The average value for the total glass sand output of the individual States in 1928 ranged from 25 cents to $5.62 a short ton.

Glass sand sold or used by producers in the United States, 1919–1928

Year	Short tons	Value		Year	Short tons	Value	
		Total	Average			Total	Average
1919	1, 827, 409	$3, 593, 371	$1. 97	1924	2, 169, 899	$3, 718, 973	$1. 71
1920	2, 165, 926	4, 748, 690	2. 19	1925	2, 334, 921	3, 836, 085	1. 64
1921	1, 280, 359	2, 314, 314	1. 81	1926	2, 274, 218	3, 615, 371	1. 59
1922	1, 768, 549	2, 866, 366	1. 62	1927	2, 171, 693	3, 257, 790	1. 50
1923	2, 034, 958	3, 751, 778	1. 84	1928	2, 310, 828	3, 435, 645	1. 49

MOLDING SAND

The production of molding sand in 1928 was 4,781,765 short tons, valued at $5,089,969, an increase of 14 per cent in both quantity and value as compared with 1927. This material was reported from 31 States in 1928. The States leading in quantity were Ohio, New

Jersey, Michigan, Illinois, New York, Pennsylvania, and Indiana, the output ranging from 782,676 tons in Ohio to 361,740 tons in Indiana. Ohio led also in total value of molding sand, with New Jersey, New York, Pennsylvania, Illinois, Michigan, and Indiana following in order; the value ranged from $1,094,370 in Ohio to $202,052 in Indiana. The average value per ton for the total output of molding sand was $1.06 in 1928, as it was also in 1927 and 1926. The average value for the total molding sand output of the individual States in 1928 ranged from 10 cents to $3.55 a short ton.

Molding sand sold or used by producers in the United States, 1919–1928

Year	Short tons	Value		Year	Short tons	Value	
		Total	Average			Total	Average
1919	3,774,612	$4,153,990	$1.10	1924	4,403,893	$4,995,268	$1.13
1920	5,128,075	7,504,759	1.46	1925	4,995,428	5,400,618	1.08
1921	1,906,977	2,451,966	1.29	1926	5,309,166	5,630,799	1.06
1922	3,839,116	4,478,405	1.17	1927	4,194,975	4,458,508	1.06
1923	5,559,644	6,730,417	1.21	1928	4,781,765	5,089,969	1.06

IMPORTS

Inports of sand and gravel into the United States in 1928 amounted to 788,222 short tons, valued at $392,111, an increase of 7 per cent in quantity and 30 per cent in value as compared with 1927. Glass sand imports amounted to 43,137 tons, valued at $35,689, and averaged 83 cents a ton. Gravel imports amounted to 359,237 tons, valued at $167,350, and averaged 47 cents a ton. Imports of sand, other than glass sand, amounted to 385,848 tons, valued at $189,072, and averaged 49 cents a ton.

Canada, as usual, was the source of most of the imported material, 88 per cent of the total coming from that country in 1928. Belgium was the source of 10 per cent of the imports, and Mexico, British India, Netherlands, and France followed in order. Smaller quantities, some of high average value, came from other countries.

The values given for imports are those upon which the import tax in this country is levied and represent the foreign market value (or the export value, if higher) plus the cost of containers and all expenses incident to placing merchandise ready for shipment to the United States, including the export tax, if any.

Sand and gravel imported for consumption in the United States, 1919–1928

Year	Short tons	Value	Year	Short tons	Value
1919	597,481	$126,586	1924	701,410	$280,206
1920	1,226,684	912,282	1925	534,555	233,422
1921	906,905	771,734	1926	947,579	341,911
1922	451,943	238,386	1927	736,271	302,551
1923	477,762	259,820	1928	788,222	392,111

Sand and gravel imported for consumption in the United States, 1926–1928, by classes

Class	1926		1927		1928	
	Short tons	Value	Short tons	Value	Short tons	Value
Glass sand	8, 817	$9, 091	10, 665	$8, 712	43, 137	$35, 689
Other sand	699, 286	242, 594	411, 797	189, 527	385, 848	189, 072
Gravel	239, 476	90, 226	313, 809	104, 312	359, 237	167, 350
	947, 579	341, 911	736, 271	302, 551	788, 222	392, 111

Sand and gravel imported into the United States, 1926–1928, by countries

[General imports]

Country	1926		1927		1928	
	Short tons	Value	Short tons	Value	Short tons	Value
North America:						
Bermuda	----	----	1	$4	----	----
Canada	846, 758	$272, 729	622, 872	211, 522	690, 358	$261, 805
Cuba	728	986	----	----	----	----
Dominican Republic	----	----	----	----	2	50
Mexico	11, 284	2, 450	32, 059	7, 780	9, 453	6, 808
South America: Brazil	----	----	----	----	58	2, 666
Europe:						
Belgium	85, 164	49, 814	76, 293	47, 684	81, 089	70, 705
Czechoslovakia	----	----	24	153	----	----
France	1, 096	7, 553	788	7, 348	1, 098	6, 848
Germany	4	61	352	110	6	199
Italy	----	----	----	----	2	21
Netherlands	299	3, 537	748	8, 191	1, 139	8, 323
Spain	6	220	----	----	----	----
Sweden	273	244	----	----	29	159
United Kingdom	1, 959	4, 114	2, 325	5, 819	339	2, 246
Asia:						
India (British)	6	152	805	13, 915	4, 647	32, 257
Japan	2	51	3	22	1	14
Palestine	----	----	----	----	1	10
Oceania: Australia	----	----	1	3	----	----
	947, 579	341, 911	736, 271	302, 551	788, 222	392, 111

EXPORTS

Exports of sand and gravel in 1928 amounted to 737,368 short tons, valued at $638,288, an increase of 75 per cent in quantity and 14 per cent in value as compared with 1927. The average value of the material exported was 87 cents a ton in 1928, as compared with $1.32 in 1927 and $1.44 in 1926.

Sand and gravel exported from the United States, 1919–1928

Year	Short tons	Value	Year	Short tons	Value
1919	(1)	$382, 070	1924	314, 140	$401, 662
1920	(1)	669, 945	1925	425, 612	496, 050
1921	(1)	379, 982	1926	424, 374	610, 023
1922	356, 520	400, 199	1927	421, 243	557, 644
1923	551, 233	598, 633	1928	737, 368	638, 288

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[1] Quantity not recorded prior to 1922.

STONE

By A. T. Coons

SUMMARY OF PRODUCTION

The total stone sold or used by the producers in the United States in 1928 amounted to 133,869,510 short tons, valued at $196,820,697. This was a decrease of 2 per cent in quantity and 1 per cent in value from the output in 1927. Granite, limestone, sandstone, and "other stone" decreased in both quantity and value. Marble decreased in quantity but increased in value. Basalt was the only variety of stone that increased in both quantity and value.

The tables in this report give the quantities sold or used by producers and the values f. o. b. at quarries and mills, so far as these are obtainable. Stone quarried and used by the producer is considered as sold and is included in the figures given for sales. The figures do not, however, include the stone made into abrasives (such as grindstones, etc.), glass sand, lime, or cement and reported in terms of finished product. These products are treated in the Mineral Resources chapters on abrasives, sand and gravel, lime, and cement. An estimate of the total amount of limestone used for all purposes is given on page 319.

Stone sold or used by producers in the United States, 1919–1928, by kinds

[Quantities approximate]

Year	Granite		Basalt and related rocks (trap rock)		Marble		Limestone	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1919	4,221,220	$19,345.714	7,410,770	$8.944,686	333,400	$8,042,297	49.759,800	$53,171,701
1920	4,760,000	24,954,908	9,219,200	12,260,148	431,500	11,069,585	59,290,000	75,655,260
1921	4,752,180	20,592,217	8,524,480	11,450.899	315,400	8,580,416	45,621,000	57,749,594
1922	5,913,120	21,125,869	10,032,900	12,600,611	427,870	10,534,671	58,928,660	68,397,927
1923	7,300,130	29,704,796	10,674,470	13,539,648	562,560	12,863,974	76,701,360	89,620,007
1924	6,883,860	28,772,161	11,671,500	14,679,523	516,000	13,302,235	75,894,430	89,868,956
1925	8.074,200	30,531,347	11,842,110	14,770,042	564,150	13,882,457	85,649,440	98,008,028
1926	9,330.390	32,044,523	12.977,740	15,950,302	563,170	14,167,480	91.887,900	109,252,299
1927	10,706,740	35,287,206	13,210,570	17.399,949	600,060	15,625,872	99,662,270	112,439,824
1928	9,556,500	33,994,527	15,327,760	19,693,945	579,490	16,402,986	96,864,650	110,231,974

Year	Sandstone		Other stone [1]		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1919	2,623,270	$5,283,842	1.190,540	$1,920,903	65,539.000	$96,709,143
1920	3,343,000	7,310,290	1,483,300	2,291.769	78,527,000	133,541,960
1921	2,640,460	6,425,339	1,685.220	2.163,801	63,538,740	106,962,266
1922	3,388,130	7,521,044	1,520,880	1,886,806	80,211,560	122,066,928
1923	4,349,270	9,174,706	3,730,870	4,567,110	103,318.660	159,470,241
1924	3,894,690	10,142,099	4,323,640	5,105,139	103,184,120	161,870.113
1925	4,479,330	10,920,016	5.242,140	6,104,902	115,851,370	174,216,792
1926	4,978,530	11,149,029	4,758,630	5,744,957	124,496,360	188,308,590
1927	5,050,600	10,923,035	7.114,890	6.971,336	136,345,130	198,647,222
1928	4,716,530	10,498,440	6,824,580	5,998,825	133,869,510	196,820,697

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[1] Includes mica schist, conglomerate, argillite, various light-colored volcanic rocks, serpentine not used as marble, and such other stone as can not be properly classed in any of the main groups.

Demand was not generally active for any class of stone and was largely influenced by local conditions. Stone for flagging, rubble, furnace flux, manufacturing industries, and miscellaneous uses showed only slight increases in output, but that for flagging and rubble showed notable increases. Building stone, monumental stone, paving blocks, crushed stone, refractory stone, and agricultural limestone decreased 1 to 8 per cent in output; riprap—the production of which is always variable—decreased even more. On account of an increase in the output of granite and of limestone and a decrease in the output of sandstone, a stone of lighter weight, curbing showed a small increase in the total tonnage sold but a decrease of less than 1 per cent in the total number of cubic feet. Operating costs and labor conditions were little different from 1927, and in general prices were reported as less in 1928 than in 1927.

Stone sold or used by producers in the United States, 1927 and 1928, by uses

Use	1927		1928	
	Quantity	Value	Quantity	Value
Building stone......cubic feet..	32, 104, 200	$40, 595, 127	30, 795, 530	$42, 769, 904
Approximate equivalent in short tons......	2, 485, 120	....	2, 453, 330	....
Monumental stone......cubic feet..	4, 325, 390	14, 978, 691	4, 203, 780	14, 966, 498
Approximate equivalent in short tons......	358, 000	....	347, 760	....
Paving blocks......number..	38, 705, 560	3, 583, 400	35, 426, 860	3, 113, 526
Approximate equivalent in short tons......	366, 740	....	349, 290	....
Curbing......cubic feet..	4, 862, 580	4, 939, 716	4, 832, 160	4, 698, 313
Approximate equivalent in short tons......	378, 230	....	383, 070	....
Flagging......cubic feet..	737, 680	573, 736	932, 900	717, 049
Approximate equivalent in short tons......	55, 160	....	74, 900	....
Rubble......short tons..	809, 020	998, 108	907, 890	1, 249, 703
Riprap......do....	4, 618, 500	4, 716, 731	3, 993, 190	3, 865, 895
Crushed stone......do....	94, 948, 770	97, 474, 267	91, 265, 360	94, 186, 259
Furnace flux (limestone and marble)......do....	21, 666, 070	15, 985, 525	23, 123, 870	16, 957, 264
Refractory stone (ganister, mica schist, and dolomite)......short tons..	1, 362, 920	1, 710, 708	1, 348, 160	1, 745, 066
Agricultural limestone......do....	2, 206, 470	3, 360, 704	2, 186, 870	3, 153, 848
Manufacturing industries (limestone and marble)......short tons..	5, 352, 130	4, 735, 114	5, 639, 750	4, 723, 810
Other uses......do....	1, 738, 000	4, 995, 395	1, 796, 070	4, 673, 562
Total (quantities approximate in short tons)..	136, 345, 130	198, 647, 222	133, 869, 510	196, 820, 697

Building stone.—Aggregate sales of building stone of all kinds decreased 4 per cent in quantity and increased 5 per cent in value over 1927. Stone sold for rough construction and for rough architectural work decreased in output, whereas dressed stone, both sawed and cut, increased. Sandstone and miscellaneous varieties of stone for construction showed decreased production, whereas granite, basalt, marble, and limestone showed increased production. The production of building stone by States is reported under the different varieties of stone.

Building stone sold or used by producers in the United States, 1927 and 1928, by kinds

Kind	Rough				Finished				Total	
	Constructional		Architectural		Sawed[1]		Cut[1]			
	Cubic feet	Value	Cubic feet	Value	Cubic feet	Value	Cubic feet	Value	Cubic feet	Value
1927										
Granite	4,324,280	$708,571	868,810	$941,706	[1] 317,990	[1]$1,325,886	[1] 886,750	[1]$4,695.949	6,397,830	$7,672,112
Basalt	276,000	33,281	----------	----------	----------	----------	----------	----------	276,000	33,281
Marble	----------	----------	859,050	2,027,236	867,390	1,985,012	1,097,350	6,726,980	2,823,790	10,739,228
Limestone	2,575,800	292.792	5,953,780	3,832,414	5,420,620	4,849,151	3,390,490	9,845,688	17,340,690	18.820,045
Sandstone	1,743,170	215,937	875,090	588,077	1,156,530	1,215,113	220,580	1,006,737	3,995,370	3,025,864
Miscellaneous	1,249,000	279,108	21,520	25,489	----------	----------	----------	----------	1,270,520	304,597
	10,168,250	1,529,689	8,578,250	7,414,922	7,762,530	9,375,162	5,595,170	22,275,354	32,104,200	40,595,127
1928										
Granite	4,286,560	714,324	1,011,260	1,280,606	[1] 493,780	[1] 839,570	[1] 912,830	[1] 4,836,513	6,704.430	7,671,013
Basalt	316,000	61,275	----------	----------	----------	----------	----------	----------	316,000	61,275
Marble	----------	----------	827,040	1,873,686	881,630	2.607,951	1,315,970	7,627,690	3,024,640	12,109,327
Limestone	1,730,500	279,434	5,255,690	3,268,140	6,047,650	4,644,923	4,607,530	12,001,466	17,641,370	20,193,963
Sandstone	681,950	149,310	759,720	472,930	943,030	1,015,750	237,990	1,005,287	2,622,690	2,643,277
Miscellaneous	486,400	91,049	----------	----------	----------	----------	----------	----------	486,400	91,049
	7,501,410	1,295,392	7,853,710	6,895,362	8,366,090	9,108,194	7,074,320	25,470,956	30,795,530	42,769,904

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[1] For granite, sawed stone corresponds to dressed stone for construction work (walls. foundations, bridges) and cut stone to architectural stone for high-class buildings.

Rubble and riprap.—In addition to the production of building stone as given in the preceding table, a large quantity of stone is reported as used for construction in the form of rubble stone or irregularly shaped stones of all sizes. This stone is used for rough walls, foundations, and other rough construction work where the stone is imbedded in mortar or plaster. It is not included, however, with the figures for regular building stone. The quantity of this class of stone used in 1928 increased considerably. Some quarrymen use the term "rubble" to include stone sold for riprap, which generally is a larger-size stone; when used for walls and foundations, usually as a protection against the encroachment of water, it is in loose piles without cementing material. The quantity of riprap produced in 1928 decreased 14 per cent, as compared with 1927.

Monumental stone.—Stone for monumental and memorial work decreased 3 per cent in quantity in 1928, but the value was practically the same as in 1927. The stone used for this class of work is chiefly marble and granite, although some limestone, not segregated in the figures, is used for this purpose. Granite for monumental work decreased less than 1 per cent in quantity but increased 3 per cent in value, and marble decreased 9 per cent in quantity and 8 per cent in value in 1928.

Paving blocks, curbstone, flagstone, and crushed stone.—Stone for flagging was the only street or road material that showed increased output in 1928. The decrease in curbstone was very small reported as cubic feet, with an increase in quantity as shown by tonnage. (See p. 294.) The quantity of paving blocks sold in 1928 decreased 8 per cent, compared with 1927. This product has declined steadily in output the last five years, the sales in 1928 being 23 per cent less than those in 1923. The total quantity of crushed stone sold decreased 4 per cent in 1928, compared with 1927; the value decreased 3 per cent. Crushed stone for concrete and road work in 1928 decreased 5 per cent in quantity and 4 per cent in value, and crushed stone reported for railroad ballast increased 3 per cent in quantity and decreased 1 per cent in value.

Fluxing stone.—Stone used by blast furnaces, open-hearth steelworks, smelters, and other metallurgic plants for fluxing increased 7 per cent in quantity and 6 per cent in value over 1927, but the output did not equal that of 1926.

Refractory stone.—Stone (dolomite, quartzite, and mica schist) reported for refractory use decreased 1 per cent in quantity. The raw dolomite reported for the manufacture of refractories in 1928 increased 20 per cent in quantity. Exact figures for raw dolomite for this purpose are difficult to obtain because sales to furnaces and smelters tend to cause it to be reported as fluxing stone. Operators who both quarry and dead-burn or sinter dolomite reported 448,761 short tons of the sintered material, valued at $4,283,036, an increase of 20 per cent in quantity. Quartzite (ganister) used in the manufacture of refractory brick, for furnace or converter lining, and for the manufacture of ferrosilicon decreased 12 per cent in quantity in 1928, and mica schist used as furnace and kiln lining increased 24 per cent.

Agricultural limestone.—Sales of agricultural limestone decreased less than 1 per cent in quantity in 1928, as compared with 1927, and burned lime used for agriculture (333,910 short tons, valued at $2,287,558, as given in the report of this series on lime) increased 3 per cent.

Manufacturing industries and "other uses."—The total quantity of stone for manufacturing industries and "other uses" increased 5 per cent in quantity and decreased 3 per cent in value in 1928.

PRODUCTION BY STATES

Pennsylvania ranks as the largest producer of stone, followed by Ohio, Michigan, New York, and Illinois. Indiana, however, ranks first in value of stone produced, followed by Pennsylvania, New York, and Ohio. Pennsylvania produces three times as much stone as Indiana and nearly 40 times as much as Vermont, which is fifth in rank of value. Pennsylvania, New York, and Ohio produce chiefly crushed stone, Indiana produces high-grade building stone and crushed stone, and Vermont produces chiefly high-grade building and monumental stone. The following table shows the relative importance of the different States in quantity and value of stone produced.

Stone sold or used by producers in the United States, 1927 and 1928, by States

State	1927			1928		
	Number of active plants	Short tons (approximate)	Value	Number of active plants	Short tons (approximate)	Value
Alabama	18	1, 238, 750	$1, 797, 375	18	1, 261, 190	$2, 197, 831
Alaska	1	(1)	(1)	1	(1)	(1)
Arizona	7	311, 930	297, 206	12	408, 210	221, 154
Arkansas	9	418, 770	486, 792	10	381, 690	441, 596
California	161	9, 764, 740	9, 963, 054	168	7, 838, 420	7, 516, 482
Colorado	45	[2] 883, 140	[2] 975, 953	43	[2] 956, 380	[2] 933, 241
Connecticut	39	2, 295, 360	3, 202, 040	40	2, 852, 980	3, 743, 572
Delaware	2	(1)	(1)	2	(1)	(1)
District of Columbia	3	6, 630	21, 350	2	(1)	(1)
Florida	53	7, 437, 580	6, 138, 767	37	3, 381, 470	2, 654, 370
Georgia	40	[2] 849, 290	[2] 6, 146, 613	40	[2] 1, 028, 060	[2] 5, 854, 226
Hawaii	9	449, 640	1, 034, 164	9	[2] 538, 740	[2] 931, 061
Idaho	23	286, 410	400, 160	43	851, 540	1, 157, 236
Illinois	72	9, 699, 530	8, 127, 506	73	9, 728, 920	8, 098, 390
Indiana	88	5, 813, 000	22, 634, 359	76	[2] 5, 102, 280	[2] 22, 720, 411
Iowa	30	1, 274, 380	1, 231, 546	35	1, 666, 270	1, 742, 252
Kansas	40	801, 450	922, 532	45	[2] 1, 203, 270	[2] 1, 212, 598
Kentucky	88	2, 603, 770	2, 863, 779	87	2, 710, 360	2, 892, 426
Louisiana	1	115, 450	169, 643	1	(1)	(1)
Maine	48	355, 800	2, 447, 644	54	413, 960	2, 579, 523
Maryland	38	1, 214, 110	2, 039, 243	40	[2] 926, 850	[2] 1, 692, 111
Massachusetts	90	[2] 2, 629, 890	[2] 7, 291, 969	93	[2] 2, 879, 990	[2] 7, 732, 247
Michigan	28	[2] 11, 442, 780	[2] 6, 560, 946	24	12, 472, 600	7, 588, 480
Minnesota	56	802, 340	4, 259, 766	61	[2] 474, 450	[2] 3, 699, 498
Mississippi	2	(1)	(1)	3	(1)	(1)
Missouri	125	[2] 3, 064, 600	[2] 5, 170, 859	118	3, 445, 690	6, 137, 631
Montana	26	219, 510	191, 021	26	235, 180	234, 334
Nebraska	4	170, 500	332, 222	5	234, 590	399, 971
Nevada	16	700, 710	570, 508	17	[2] 824, 910	[2] 601, 664
New Hampshire	25	[2] 178, 300	[2] 1, 584, 262	26	[2] 166, 040	[2] 1, 423, 426
New Jersey	44	2, 760, 880	4, 334, 526	44	3, 186, 940	4, 578, 642
New Mexico	1	(1)	(1)	1	(1)	(1)
New York	140	[2] 10, 651, 610	[2] 15, 830, 959	132	[2] 10, 743, 470	[2] 15, 785, 511
North Carolina	38	[2] 2, 250, 870	[2] 4, 913, 177	34	2, 126, 560	4, 690, 949
Ohio	126	[2] 15, 631, 240	[2] 16, 769, 636	128	13, 717, 410	14, 195, 607
Oklahoma	28	[2] 1, 720, 050	[2] 1, 514, 538	27	[2] 1, 986, 890	[2] 1, 743, 588
Oregon	103	1, 863, 830	1, 951, 631	103	1, 875, 250	2, 117, 322
Pennsylvania	415	16, 015, 480	18, 999, 592	401	16, 546, 850	18, 871, 736
Porto Rico	12	113, 780	209, 476	14	79, 730	136, 341
Rhode Island	19	[2] 153, 400	[2] 734, 164	17	149, 130	707, 257
South Carolina	12	1, 197, 870	1, 992, 558	15	1, 278, 190	2, 203, 863
South Dakota	23	264, 500	535, 232	25	172, 360	451, 869
Tennessee	71	2, 145, 390	6, 430, 631	47	[2] 2, 335, 530	[2] 7, 288, 666
Texas	42	3, 267, 940	2, 534, 866	40	3, 130, 050	2, 522, 495
Utah	53	[2] 739, 830	[2] 561, 932	20	881, 730	818, 415

[1] Included under "Undistributed."

[2] To avoid disclosing confidential information, certain State totals are slightly incomplete, the figures not included being combined under "Undistributed."

Stone sold or used by producers in the United States, 1927 and 1928, by States—Continued

State	1927			1928		
	Number of active plants	Short tons (approximate)	Value	Number of active plants	Short tons (approximate)	Value
Vermont	38	321,970	$9,216,116	43	[2] 448,060	[2] $9,438,796
Virginia	92	[2] 3,140,170	[2] 3,320,385	94	[2] 3,289,350	[2] 3,358,104
Washington	64	975,850	958,841	101	1,037,160	1,325,768
West Virginia	38	3,171,120	2,962,922	25	[2] 3,143,780	[2] 2,908,657
Wisconsin	144	[2] 3,104,240	[2] 5,181,631	140	3,313,740	5,516,017
Wyoming	14	253,230	431,104	15	[2] 280,180	[2] 454,136
Undistributed		1,573,520	2,402,026		2,163,110	3,301,227
	2,704	136,345,130	198,647,222	2,675	133,869,510	196,820,697

[2] To avoid disclosing confidential information, certain State totals are slightly incomplete, the figures not included being combined under "Undistributed."

EXPORTS AND IMPORTS[1]

Value of stone exported from the United States, 1919–1928

Year	Marble in blocks, rough or dressed, and other building or monumental stone [1]	Other manufactures of stone [1]	Total	Year	Marble in blocks, rough or dressed, and other building or monumental stone [1]	Other manufactures of stone [1]	Total
1919	$770,392	$1,508,997	$2,279,389	1924	$499,602	$448,731	$948,333
1920	774,442	2,158,764	2,933,206	1925	507,391	725,677	1,233,068
1921	576,905	1,697,570	2,274,475	1926	687,115	896,130	1,583,245
1922	681,658	903,102	1,584,760	1927 [2]	[3] 1,088,949	[4] 1,005,636	2,094,585
1923	625,442	783,195	1,408,637	1928 [2]	[3] 727,432	[4] 1,245,792	1,973,224

[1] Exports classification beginning 1922; prior to 1922 classification read "Stone including marble—unmanufactured and all other."

[2] Figures not separately recorded for 1927 and 1928 for stone and for cement building blocks and for stone and for cement manufactures.

[3] Composed in 1927 of "marble in blocks, rough or dressed," $237,233, and "other building or monumental stone (including cement building blocks)," $851,716; in 1928 of $254,266 and $473,166, respectively.

[4] Classification reads "Other manufactures of stone (including other cement manufactures)."

Stone exported from the United States in 1928, by countries

Country	Marble in blocks, rough or dressed		Other building or monumental stone (including cement building blocks) [a]		Other manufactures of stone (including paving blocks and curbing and cement manufactures) [a]	Total value
	Cubic feet	Value	Cubic feet	Value		
North America:						
Canada	56,922	$220,749	649,794	$462,497	$797,651	$1,480,897
Central America—						
British Honduras					1,661	1,661
Costa Rica					2,575	2,575
Guatemala					1,586	1,586
Honduras	25	32			1,124	1,156

[a] Figures not separately recorded for 1928 for stone and for cement building blocks and for stone and for cement mnaufactures.

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[1] Figures on exports and imports compiled by J. A. Dorsey, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.

Stone exported from the United States in 1928, by countries—Continued

Country	Marble in blocks, rough or dressed		Other building or monumental stone (including cement building blocks)		Other manufactures of stone (including paving blocks and curbing and cement manufactures)	Total value
	Cubic feet	Value	Cubic feet	Value		
North America—Continued.						
Central America—Continued.						
Nicaragua					$1,040	$1,040
Panama	5	$27			8,498	8,525
Salvador					907	907
Mexico	746	7,263	878	$3,324	41,881	52,468
Newfoundland and Labrador	1,269	6,659	160	1,413	13,300	21,372
West Indies—						
British—						
Barbados			6	151	7	158
Bermuda	327	1,275	250	1,207	543	3,025
Jamaica	51	132			1,557	1,689
Trinidad and Tobago	6	27			278	305
Other	163	829	44	255	3,814	4,898
Cuba	38	724	116	210	90,924	91,858
Dominican Republic	37	135	10	18	6,957	7,110
Haiti	21	1,079			2,361	3,440
Netherland			18	200	13,314	13,514
Virgin Islands of the United States			8	20	599	619
Other					12	12
South America:						
Argentina					8,777	8,777
Brazil					2,920	2,920
Chile					567	567
Colombia	160	588			17,600	18,188
Ecuador					721	721
Peru	2,039	4,426			775	5,201
Venezuela	102	823			6,792	7,615
Other					815	815
Europe:						
France					15,225	15,225
Germany					22,010	22,010
Italy	2	75			2,025	2,100
Netherlands					4,836	4,836
United Kingdom	2,060	7,721	1,077	1,329	43,984	53,034
Other			82	384	10,662	11,046
Asia:						
China	50	600			2,505	3,105
India (British)					31,784	31,784
Japan	296	1,059	175	700	34,767	36,526
Philippine Islands					2,786	2,786
Other			9	75	9,334	9,409
Africa:						
Union of South Africa					4,067	4,067
Other	5	15			2,063	2,078
Oceania:						
Australia			214	515	21,759	22,274
New Zealand			267	868	8,009	8,877
Other	2	28			420	448
	64,326	254,266	653,108	473,166	1,245,792	1,973,224

Value of stone imported for consumption in the United States, 1919–1928

1919	$787,961	1924	$2,437,654
1920	1,795,575	1925	2,909,887
1921	1,253,959	1926	3,523,578
1922	1,895,912	1927	4,536,407
1923	2,641,337	1928	3,491,353

Stone imported for consumption in the United States, 1927 and 1928, by kinds

Kind	1927		1928	
	Quantity	Value	Quantity	Value
Marble, breccia, and onyx:				
In blocks, rough, etc. ....cubic feet..	958,429	$2,521,917	586,061	$1,673,344
Sawed ....do....	812	4,665	8	19
Slabs or paving tiles ....superficial feet..	925,792	306,696	845,464	310,785
All other manufactures		561,990		483,071
Mosaic cubes of marble or onyx:				
Loose		9,144		6,015
Attached to paper		74		111
		3,404,486		2,473,345
Granite:				
Dressed		319,644		244,043
Rough ....cubic feet..	188,395	257,470	178,427	272,428
		577,114		516,471
Stone (other):				
Dressed		27,830		40,007
Rough (monumental or building stone) ....cubic feet..	279,422	240,987	244,346	237,595
Rough (other)		285,990		223,935
		554,807		501,537
Grand total		4,536,407		3,491,353

Marble, breccia, and onyx (rough and manufactured) imported into the United States, 1927 and 1928, by countries

[General imports]

Country	1927				1928			
	Rough marble, breccia, and onyx		Manufactured	Total value	Rough marble, breccia, and onyx		Manufactured	Total value
	Cubic feet	Value			Cubic feet	Value		
Canada	14	$58	$4,429	$4,487			$769	$769
Cuba			895	895			923	923
Dominican Republic					12	$10		10
Guatemala					1,062	2,507		2,507
Mexico	26,509	96,062	2,264	98,326	24,631	97,855	114	97,969
Total North America	26,523	96,120	7,588	103,708	25,705	100,372	1,806	102,178
Belgium	93,915	166,763	65,153	231,916	61,633	108,273	61,419	169,692
France	68,098	132,431	109,056	241,487	70,090	152,444	131,109	283,553
Germany	7,225	17,408	85,172	102,580	13,152	43,178	88,442	131,620
Greece	16,273	69,457	124	69,581	15,470	73,776	64	73,840
Italy	726,281	1,997,092	552,445	2,549,537	384,494	1,121,822	471,274	1,593,096
Netherlands			500	500	2,018	2,812	430	3,242
Spain	11,839	27,104	1,928	29,032	10,322	26,392	415	26,807
United Kingdom	292	1,065	15,836	16,901	100	344	13,665	14,009
Other Europe [1]	501	471	14,966	15,437	2,364	4,719	21,187	25,906
Total Europe	924,424	2,411,791	845,180	3,256,971	559,643	1,533,760	788,005	2,321,765
China			16,401	16,401			10,384	10,384
Japan			8,031	8,031			2,856	2,856
Other countries [2]	3,146	22,895	2,929	25,824	5,163	56,627	1,539	58,166
	3,146	22,895	27,361	50,256	5,163	56,627	14,779	71,406
Grand total	954,093	2,530,806	880,129	3,410,935	590,511	1,690,759	804,590	2,495,349

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[1] 1927: Austria, Czechoslovakia, Denmark, Finland, Gibraltar, Hungary, Irish Free State, Latvia, Malta, Rumania, Sweden, Switzerland, and Yugoslavia and Albania; 1928: Austria, Denmark, Finland, Hungary, Irish Free State, Portugal, Rumania, Sweden, and Switzerland.

[2] 1927: Algeria and Tunisia, Argentina, Australia, Ceylon, Chile, Egypt, Hong Kong, India (British), Palestine, and Siam; 1928: Algeria and Tunisia, Argentina, Australia, Ecuador, Egypt, Hong Kong, India (British), Palestine, Syria, and Uruguay.

Value of building or monumental stone (exclusive of marble, breccia, and onyx) and other classes of stone imported into the United States, 1927 and 1928, by countries

[General imports]

Country	1927			1928		
	Building or monumental stone	Other stone	Total	Building or monumental stone	Other stone	Total
North America:						
Canada	$43,359	$275,235	$318,594	$34,277	$211,857	$246,134
Mexico				57		57
Total North America	43,359	275,235	318,594	34,334	211,857	246,191
Europe:						
Austria	26		26	39		39
Belgium	282	20	302	5,634		5,634
Czechoslovakia	37,675		37,675	37,919		37,919
Denmark		755	755	2,021	625	2,646
Finland	126,921		126,921	82,840		82,840
France	59,908	21	59,929	81,382	128	81,510
Germany	84,597	3,919	88,516	106,474	9,786	116,260
Italy	264,754		264,754	211,252		211,252
Netherlands		2,871	2,871	1,493	114	1,607
Norway	17,806	970	18,776	15,044		15,044
Portugal	9,029		9,029	9,076		9,076
Spain				849		849
Sweden	165,611		165,611	182,611		182,611
United Kingdom	51,345	2,062	53,407	29,550	10,955	40,505
Other Europe	8,944		8,944	30		30
Total Europe	826,898	10,618	837,516	766,214	21,608	787,822
Other countries [1]	3,458	582	4,040	3,045	76	3,121
Grand total	873,715	286,435	1,160,150	803,593	233,541	1,037,134

[1] 1927: Australia, Chile, China, Egypt, Hong Kong, Hungary, India (British), Japan, Malta and Gozo and Cyprus, Palestine, and Switzerland; 1928: Canary Islands, Ceylon, China, Cuba, Hong Kong, and Japan.

PRODUCTION BY KINDS AND STATES

GRANITE

The output of granite in 1928 (9,556,500 short tons, valued at $33,994,527) decreased 11 per cent in quantity and 4 per cent in value compared with 1927. The greatest decrease was in the quantity and value of riprap reported. This was due largely to decreased operations in a quarry that had been operated to furnish stone for special harbor work. Granite for monumental work decreased less than 1 per cent in quantity and increased 3 per cent in value. Granite for paving blocks decreased 8 per cent in quantity, and rubble stone also decreased. Crushed stone, which comprised 73 per cent of the total quantity of granite produced in 1928, decreased 6 per cent in both quantity and value. Crushed stone for concrete and road metal decreased 7 per cent and that for railroad ballast 4 per cent. Granite for construction increased 5 per cent in quantity but decreased slightly in value of output. The increase was in the quantity of high-grade stone sold—rough architectural, dressed construction, and cut stone—as stone used for rough construction decreased in output. Granite for curbing increased 3 per cent in quantity and that sold for various miscellaneous uses showed considerable increase over 1927.

Granite sold or used by producers in the United States, 1927 and 1928, by uses

Use	1927		1928	
	Quantity	Value	Quantity	Value
Building stone (rough and dressed)..........cubic feet..	6,397,830	$7,672,112	6,704,430	$7,671,013
Approximate equivalent in short tons	537,360		556,670	
Monumental stone..........cubic feet..	3,197,910	10,881,442	3,172,730	11,217,229
Approximate equivalent in short tons	262,180		260,210	
Paving..........number of blocks..	35,949,790	3,368,178	32,949,300	2,934,604
Approximate equivalent in short tons	334,230		321,300	
Curbing..........linear feet..	3,431,290	2,605,478	3,548,220	2,607,152
Approximate equivalent in short tons	171,130		190,070	
Rubble..........short tons..	484,770	426,587	310,720	321,442
Riprap..........do....	1,453,390	1,327,510	806,990	660,955
Crushed stone..........do....	7,416,860	8,894,201	6,939,310	8,375,033
Other uses..........do....	46,820	111,698	171,230	207,099
Total (quantities approximate, in short tons)	10,706,740	35,287,206	9,556,500	33,994,527

California made the largest output of granite in 1928, followed by North Carolina and South Carolina. Massachusetts was the leading State in value of granite output, followed by Vermont and North Carolina. North Carolina, however, produced seven times as much stone as Vermont and two and one-half times as much as Massachusetts. This is accounted for by the large quantity of crushed stone included in the output of North Carolina and of Massachusetts.

Granite sold or used by producers in the United States, 1927 and 1928, by States

[Quantities approximate]

State	1927		1928	
	Short tons	Value	Short tons	Value
Arizona	(1)	(1)	51,340	$38,832
Arkansas			(1)	(1)
California	3,026,210	$3,439,119	1,981,500	2,202,585
Colorado	29,270	179,591	44,750	205,785
Connecticut	96,140	660,014	48,260	429,152
Delaware	(1)	(1)	(1)	(1)
District of Columbia	6,630	21,350	(1)	(1)
Georgia	595,040	2,730,937	415,830	2,275,232
Idaho	(1)	(1)	(1)	(1)
Maine	225,910	2,242,262	280,690	2,358,375
Maryland	328,740	602,293	280,440	699,574
Massachusetts	779,120	4,461,922	716,780	4,596,457
Minnesota	45,940	2,672,239	53,860	2,649,004
Missouri	21,430	90,133	14,110	69,707
Montana	21,880	34,300	14,090	45,291
New Hampshire	178,300	1,584,262	166,040	1,423,426
New Jersey	(1)	(1)	(1)	(1)
New York	117,370	850,158	122,690	1,056,630
North Carolina	1,866,950	4,453,971	1,868,860	4,342,718
Oklahoma	31,550	143,228	37,790	156,354
Oregon	(1)	(1)	(1)	(1)
Pennsylvania	357,010	843,704	328,330	677,372
Rhode Island	77,780	574,229	100,950	607,495
South Carolina	1,197,870	1,992,558	1,278,190	2,203,863
South Dakota	4,450	215,168	12,700	243,148
Texas	10,970	153,208	26,550	195,409
Utah	9,700	14,213		
Vermont	111,770	3,982,272	264,200	4,351,724
Virginia	495,950	559,898	787,620	772,838
Washington	279,190	187,412	80,310	86,920
Wisconsin	318,980	2,158,522	391,130	1,971,422
Undistributed	472,590	440,243	189,490	335,214
	10,706,740	35,287,206	9,556,500	33,994,527

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[1] Included under "Undistributed."

The following table shows the uses of the stone produced and sold by the quarrymen in the various States.

Granite sold or used by producers in the United States in 1928, by States and uses

State	Number of active plants	Building						Monumental stone				Paving blocks	
		Rough				Dressed		Rough		Dressed		Number	Value
		Construction		Architectural									
		Short tons	Value	Cubic feet	Value	Cubic feet	Value	Cubic feet	Value	Cubic feet	Value		
Arizona	2												
Arkansas	1												
California	29	1,000	$2,540	(2)	(2)	[2] 23,680	[2] $162,338	66,220	$135,372	37,540	$320,540		
Colorado	8			(1)	(1)			8,800	12,602	16,090	132,438		
Connecticut	12	5,710	8,874	(2)	(2)	[2] 13,240	[2] 83,880	47,460	120,328	16,600	120,801	(1)	(1)
Delaware	2	(1)	(1)										
District of Columbia	2	(1)	(1)										
Georgia	27	(1)	(1)			199,590	521,131	168,400	270,758	17,980	138,846	4,348,980	$378,797
Idaho	2							(1)	(1)				
Maine	45	1,250	1,021	357,400	$317,676	92,960	248,436	118,380	124,437	5,280	30,988	12,930,970	1,233,103
Maryland	12	94,060	196,529	[3] 52,160	[3] 178,546	(3)	(3)	(1)	(1)	(1)	(1)	5,000	450
Massachusetts	46	28,040	32,458	296,500	522,764	505,990	1,150,396	176,240	399,475	67.580	501,719	3,764,860	384,085
Minnesota	30			55,940	68,316	241,450	1,008,909	126,000	317,241	153,780	1,243,238	(1)	(1)
Missouri	5	(1)	(1)					(1)	(1)			276,000	24,925
Montana	13	(1)	(1)	(2)	(2)	[2] 2,340	[2] 8,206	(2)	(2)	[2] 5,770	[2] 29,257		
New Hampshire	24	2,080	2,562	66,600	63,489	71,950	610,920	78,700	126,953	20,170	125,506	2,509,330	153,183
New Jersey	1												
New York	13	7,800	9,331	(2)	(2)	[2] 103,640	[2] 767,398	5,950	12,197	21,980	160,065		
North Carolina	29	23,740	54,680	(2)	(2)	[2] 220,490	[2] 931,272	[3] 82,780	[3] 337,349	(3)	(3)	4,269,650	308,328
Oklahoma	9					(1)	(1)	12,260	23,175	13,800	106,195		
Oregon	1							(1)	(1)				
Pennsylvania	33	117,970	296,162	[3] 14,040	[3] 30,176	(3)	(3)	(1)	(1)	(1)	(1)	(1)	(1)
Rhode Island	14	1,220	791			8,700	17,553	(2)	(2)	[2] 88,720	[2] 380,011		
South Carolina	15			(1)	(1)	(1)	(1)	(1)	(1)			(1)	(1)
South Dakota	7	(1)	(1)					3,240	8,638	27,510	212,260		
Texas	7	15,630	27,750	12,000	14,871	6,440	21,000	[3] 45,790	[3] 127,463	(3)	(3)		
Vermont	27	(1)	(1)	(2)	(2)	[2] 26,020	[2] 175,455	1,362,780	3,831,755	31,780	220,315	(1)	(1)
Virginia	10	1,130	2,884	(1)	(1)			(1)	(1)	(1)	(1)		
Washington	15					(1)	(1)	(2)	(2)	[2] 5,100	[2] 24,488		
Wisconsin	23			[3] 5,560	[3] 27,095	(3)	(3)	17,080	41,380	109,720	1,111,959	4,179,570	393,983
Undistributed		57,110	78,742	38,670	18,649	2,510	8,213	206,170	416,064	7,080	53,416	664,940	57,750
	464	356,740	714,324	1,011,260	1,280,606	1,406,610	5,676,083	2,593,270	6,369,495	579,460	4,847,734	32,949,300	2,934,604

[1] Included under "Undistributed."

[2] Rough stone included under dressed stone.

[3] Dressed stone included under rough stone.

Granite sold or used by producers in the United States in 1928, by States and uses—Continued

State	Curbing		Rubble		Riprap		Crushed stone				Other uses		Total	
							Concrete and road metal		Railroad ballast					
	Linear feet	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons (approximate)	Value
Arizona					31,230	$8,726	20,110	$30,106					51,340	$38,832
Arkansas					(1)	(1)							(1)	(1)
California	(1)	(1)			433,130	390,673	1,026,260	846,251	509,080	$340,256	(1)	(1)	1,981,500	2,202,585
Colorado							41,540	52,798			(1)	(1)	44,750	205,785
Connecticut	61,500	$62,461	(1)	(1)	29,720	16,640	(1)	(1)			(1)	(1)	48,260	429,152
Delaware							(1)	(1)					(1)	(1)
District of Columbia	(1)	(1)	(1)	(1)									(1)	(1)
Georgia	1,207,130	653,127	38,020	$23,179	(1)	(1)	198,930	238,222	32,620	35,177	(1)	(1)	415,830	2,275,232
Idaho							(1)	(1)					(1)	(1)
Maine	334,640	290,054	4,000	4,000	9,640	9,106	74,040	98,406			530	$1,148	280,690	2,358,375
Maryland	32,500	12,518	21,780	42,903	(1)	(1)	69,500	109,496	(1)	(1)	(1)	(1)	280,440	699,574
Massachusetts	709,290	706,474	54,840	52,297	38,190	29,745	417,640	804,286			3,550	12,758	716,780	4,596,457
Minnesota			(1)	(1)	(1)	(1)							53,860	2,649,004
Missouri					(1)	(1)	(1)	(1)					14,110	69,707
Montana			(1)	(1)	12,720	7,251							14,090	45,291
New Hampshire	330,030	263,796	42,980	12,820	31,110	25,050	23,300	35,924	50	78	2,320	3,145	166,040	1,423,426
New Jersey							(1)	(1)					(1)	(1)
New York	(1)	(1)	(1)	(1)			29,800	39,456	(1)	(1)	(1)	(1)	122,690	1,056,630
North Carolina	839,290	590,363	10,220	31,443	15,640	9,720	1,470,770	1,830,427	197,920	190,179	42,260	58,957	1,868,860	4,342,718
Oklahoma			570	569	(1)	(1)	(1)	(1)	(1)	(1)			37,790	156,354
Oregon													(1)	(1)
Pennsylvania	(1)	(1)	43,740	60,896	(1)	(1)	122,250	167,107	40,000	48,000	(1)	(1)	328,330	677,372
Rhode Island	15,700	15,352					90,450	193,788					100,950	607,495
South Carolina	(1)	(1)	5,120	8,321	(1)	(1)	1,189,790	1,732,420	10,420	16,672	(1)	(1)	1,278,190	2,203,863
South Dakota					(1)	(1)	10,000	22,000			(1)	(1)	12,700	243,148
Texas			(1)	(1)	(1)	(1)					(1)	(1)	26,550	195,409
Vermont	(1)	(1)			(1)	(1)	40,150	53,550					264,200	4,351,724
Virginia			(1)	(1)			159,260	185,852	603,090	541,815	(1)	(1)	787,620	772,838
Washington			(1)	(1)	36,720	20,323	33,790	31,157			(1)	(1)	80,310	86,920
Wisconsin	9,850	7,195	(1)	(1)	(1)	(1)	216,940	290,261			53,420	37,272	391,130	1,971,422
Undistributed	8,290	5,812	89,450	85,014	168,890	143,721	172,790	295,612	138,820	145,737	69,150	93,819	189,490	335,214
	3,548,220	2,607,152	310,720	321,442	806,990	660,955	5,407,310	7,057,119	1,532,000	1,317,914	[4] 171,230	[4] 207,099	9,556,500	33,994,527

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[1] Included under "Undistributed."

[4] Includes 6,140 tons of Durax blocks, valued at $51,695, made in Georgia, Massachusetts, North Carolina, Washington, and Wisconsin.

The following table gives statistics covering sales of monumental granite by the quarrymen at Quincy, Mass., during the past 10 years. The quarry operators furnishing this stone in 1928 were the Granite Railway Co., Gray Rock Granite Co. (Inc.), C. H. Hardwick & Co., The Quincy Quarries Co., Rock Quarry Co., and J. S. Swingle (Inc.), all of Quincy; these quarries also furnished stone for construction. Crushed-stone plants also are operated in the vicinity of Quincy.

Monumental granite sold by the quarrymen at Quincy, Mass., 1919–1928

Year	Number of active plants	Short tons (approximate)	Value	Year	Number of active plants	Short tons (approximate)	Value
1919	8	32, 000	$614, 005	1924	6	26, 630	$527, 915
1920	8	27, 000	674, 233	1925	7	26, 500	509, 329
1921	6	14, 000	311, 178	1926	7	23, 000	438, 963
1922	6	16, 000	341, 601	1927	5	21, 130	375, 613
1923	6	27, 150	596, 709	1928	6	12, 400	369, 184

The following table shows the quantity and value of monumental granite sold by the quarrymen in the Barre district of Vermont during the past 10 years. The quarry operators in this district in 1928 were the Barre Granite Quarrying Co., Capitol Hill Quarry Co., Jones Bros. (Inc.), Littlejohn & Milne Quarry Co., James K. Pirie Estate, Rock of Ages Corporation, E. L. Smith & Co., Standard Granite Co. (Inc.), Steel Quarry Co., Wells-Lamson Quarry Co., and Wetmore & Morse Granite Co., all of Barre. Granite from this district is used also for construction and for the manufacture of paving blocks.

Monumental granite sold by the quarrymen in the Barre district, Vermont, 1919–1928

Year	Cubic feet	Value	Year	Cubic feet	Value
1919	1, 376, 000	$3, 623, 055	1924	1, 025, 930	$3, 366, 497
1920	1, 147, 800	3, 957, 881	1925	981, 560	3, 192, 282
1921	686, 947	2, 417, 024	1926	1, 062, 160	3, 311, 066
1922	453, 000	1, 395, 911	1927	1, 115, 400	3, 426, 732
1923	1, 208, 010	3, 300, 805	1928	1, 225, 800	3, 395, 628

Through the kindness of the Granite Manufacturers' Association, Barre, the following figures covering the entire granite industry of the Barre district are given to supplement the figures of sales reported to the Bureau of Mines by the quarrymen.

Estimated output of monumental granite in Barre district, Vermont, 1925–1928

	1925	1926	1927	1928
Total quarry output, rough stock cubic feet	1, 161, 684	1, 169, 322	1, 179, 822	1, 549, 443
Shipped out of Barre district in rough do	232, 336	233, 884	235, 964	309, 889
Manufactured in Barre district do	929, 348	935, 438	943, 858	1, 239, 554
Light stock consumed in district do	580, 843	584, 649	589, 910	774, 720
Dark stock consumed in district do	348, 505	350, 789	353, 948	464, 834
Number of cutters in district	1, 100	1, 100	1, 200	1, 600
Average daily wage	$8. 00	$8. 00	$9. 00	$9. 00
Average number of days worked	275	272	227	256
Total pay roll for year	$2, 420, 000	$2, 393, 600	$2, 451, 600	$3, 686, 400
Estimated overhead	1, 210, 000	1, 196, 800	1, 225, 800	1, 843, 200
Estimated value of light stock	2, 613, 789	2, 630, 973	2, 654, 600	3, 486, 240
Estimated value of dark stock	1, 873, 215	1, 885, 533	1, 902, 463	2, 498, 484
Estimated polishing cost	735, 000	739, 830	743, 500	980, 334
Output from saws	245, 000	246, 610	325, 000	326, 778
Total value of granite	9, 097, 004	9, 093, 346	9, 302, 963	12, 821, 436

The figures of quantity submitted by the association represent the stone carried to Barre from the quarries by truck and railroad. The figures of the Bureau of Mines represent the sales of stone as reported by the quarry operators. T. T. Lawson, secretary of the Granite Manufacturers' Association, states that the apparent large increase in 1928 in the total value of the granite output for the district is due largely to a more thorough investigation of the number of cutters employed in the district.

BASALT AND RELATED ROCKS (TRAP ROCK)

The only variety of stone to show increase in both quantity and value of output (15,327,760 short tons, valued at $19,693,945) in 1928 was basalt and related rocks. This increase amounted to 16 per cent in quantity and 13 per cent in value. Crushed stone, which comprised 97 per cent of the production in 1928, increased 17 per cent in quantity and 16 per cent in value over 1927. Crushed basalt for road metal and concrete increased 22 per cent in quantity, and that for railroad ballast decreased 12 per cent. Under "Other" is reported 84,910 short tons of roofing granules, valued at $582,952, made chiefly from altered diabase (greenstone). In the figures for granite, sandstone, marble, and miscellaneous varieties of stone is also an amount of "roofing granules," which increases the total output of roofing granules made from stone to 107,830 short tons, valued at $667,435. Besides these "roofing granules," others of slate (including slate "flour") amounting to 413,980 tons, valued at $2,468,471, were sold by producers in 1928.

Basalt and related rocks (trap rock) sold or used by producers in the United States, 1927 and 1928, by uses

Use	1927		1928	
	Quantity	Value	Quantity	Value
Building stone......cubic feet..	276,000	$33,281	316,000	$61,275
Approximate equivalent in short tons......	23,300	....	32,360	....
Rubble......short tons..	67,610	125,319	64,390	40,390
Riprap......do....	297,780	583,688	275,160	372,881
Crushed stone......do....	12,686,250	15,832,220	14,796,790	18,375,468
Other (principally roofing granules)......do....	135,630	825,441	159,060	843,931
Total (quantities approximate, in short tons)......	13,210,570	17,399,949	15,327,760	19,693,945

Basalt and related rocks (trap rock) sold or used by producers in the United States, 1927 and 1928, by States

[Quantities approximate]

State	1927		1928	
	Short tons	Value	Short tons	Value
California......	943,700	$877,088	992,440	$890,264
Connecticut......	2,150,000	2,446,806	2,751,890	3,122,644
Hawaii......	449,640	1,034,164	538,740	931,061
Idaho......	231,980	271,540	720,060	949,013
Maryland......	562,280	894,381	362,060	571,182
Massachusetts......	1,383,110	1,543,715	1,648,730	1,926,458
Michigan......	107,000	317,195	91,360	181,331
Minnesota......	227,050	459,603	89,390	290,620
Montana......	(1)	(1)	(1)	(1)
New Jersey......	2,388,700	3,654,404	2,925,110	4,025,637
New York......	(1)	(1)	(1)	(1)
Oregon......	1,443,150	1,527,447	1,530,430	1,670,627
Pennsylvania......	1,602,210	2,266,435	1,455,780	2,192,441
Texas......	(1)	(1)	(1)	(1)
Virginia......	11,920	18,253	(1)	(1)
Washington......	629,010	477,746	860,210	886,930
Wisconsin......	(1)	(1)	1)	(1)
Undistributed......	1,080,820	1,611,172	1,361,560	2,055,737
	13,210,570	17,399,949	15,327,760	19,693,945

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[1] Included under "Undistributed."

Basalt and related rocks (trap rock) sold or used by producers in the United States in 1928, by uses

State	Number of active plants	Building, rough construction		Rubble and riprap		Crushed stone				Other uses		Total	
						Concrete and road metal		Railroad ballast					
		Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons (approximate)	Value
California	20			74, 280	$37, 100	784, 550	$676, 135	107, 220	$86, 498	26, 390	$90, 531	992, 440	$890, 264
Connecticut	20	15, 110	$29, 417	(1)	(1)	2, 577, 890	2, 929, 494	152, 030	153, 605	(1)	(1)	2, 751, 890	3, 122, 644
Hawaii	8	(1)	(1)	(1)	(1)	409, 450	705, 402			(1)	(1)	538, 740	931, 061
Idaho	35			1, 350	682	718, 710	948, 331					720, 060	949, 013
Maryland	8	5, 580	8, 410	(1)	(1)	146, 690	255, 346	(1)	(1)	(1)	(1)	362, 060	571, 182
Massachusetts	19	(1)	(1)	(1)	(1)	1, 377, 500	1, 648, 502	258, 120	270, 376			1, 648, 730	1, 926, 458
Michigan	5					(1)	(1)			(1)	(1)	91, 360	181, 331
Minnesota	4			(1)	(1)	54, 830	67, 460	(1)	(1)	(1)	(1)	89, 390	290, 620
Montana	1							(1)	(1)			(1)	(1)
New Jersey	34	560	444			2, 626, 560	3, 657, 054	297, 990	368, 139			2, 925, 110	4, 025, 637
New York	3					(1)	(1)					(1)	(1)
Oregon	92			34, 020	35, 431	1, 464, 750	1, 598, 374	31, 660	36, 822			1, 530, 430	1, 670, 627
Pennsylvania	20	8, 460	20, 004	1, 250	1, 986	937, 290	1, 213, 312	421, 610	510, 299	87, 170	446, 840	1, 455, 780	2, 192, 441
Texas	1			(1)	(1)	(1)	(1)	(1)	(1)			(1)	(1)
Virginia	1					(1)	(1)					(1)	(1)
Washington	70			80, 970	96, 657	726, 200	739, 857	52, 580	47, 668	460	2, 748	860, 210	886, 930
Wisconsin	1					(1)	(1)					(1)	(1)
Undistributed		2, 650	3, 000	147, 680	241, 415	1, 289, 630	2, 034, 011	361, 530	428, 783	45, 040	303, 812	1, 361, 560	2, 055, 737
	342	32, 360	61, 275	339, 550	413, 271	13, 114, 050	16, 473, 278	1, 682, 740	1, 902, 190	159, 060	843, 931	15, 327, 760	19, 693 945

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[1] Included under "Undistributed."

MARBLE

The total amount of marble sold in 1928—579,490 short tons, valued at $16,402,986—represented a decrease of 3 per cent in quantity and an increase of 5 per cent in value from 1927. The decrease was in the rough marble sold by tonnage for terrazzo, stucco, mosaic, marble dust, and by-product stone such as rubble, riprap, flux, and other rough stone. Dimension stone used for construction and for monumental and memorial work increased nearly 3 per cent in quantity and 7 per cent in value. Marble for building stone increased 7 per cent in quantity, and that for monumental stone decreased 8.5 per cent.

Marble sold by producers in the United States, 1927 and 1928, by uses

Use	1927		1928	
	Quantity	Value	Quantity	Value
Building stone:				
Rough—				
Exterior...cubic feet..	144,130	$291,596	263,770	$503,176
Interior...do....	714,920	1,735,640	563,270	1,370,510
Finished—				
Exterior...do....	706,340	2,534,483	755,720	2,643,026
Interior...do....	1,258,400	6,177,509	1,441,880	7,592,615
Total exterior...do....	850,470	2,826,079	1,019,490	3,146,202
Total interior...do....	1,973,320	7,913,149	2,005,150	8,963,125
Total building stone...do....	[1] 2,823,790	[1] 10,739,228	[1] 3,024,640	[1] 12,109,327
Monumental stone:				
Rough...do....	149,920	149,468	164,300	193,948
Finished...do....	977,560	3,947,781	866,750	3,555,321
Total monumental stone...do....	[1] 1,127,480	[1] 4,097,249	[1] 1,031,050	[1] 3,749,269
Total building and monumental...cubic feet...	3,951,270	14,836,477	4,055,690	15,858,596
Total building and monumental...approximate short tons..	333,820	....	342,590	....
Marble for other uses (by-products)...short tons..	266,240	789,395	236,900	544,390
Total marble, approximate short tons...	600,060	15,625,872	579,490	16,402,986

[1] Building-stone figures may be somewhat less than given and monumental stone somewhat more, as some of the Tennessee producers were unable to divide their product according to use.

Marble sold by producers in the United States, 1927 and 1928, by States and uses

State	Building and monumental (rough and finished)		Other uses		Total	
	Cubic feet	Value	Short tons	Value	Short tons (approximate)	Value
1927						
Alabama	101,920	$614,910	28,720	$56,178	37,380	$671,088
California	24,170	74,001	1,530	12,924	3,580	86,925
Georgia	553,140	3,053,879	7,500	11,700	54,520	3,065,579
Massachusetts	31,980	183,321	1,760	2,830	4,480	186,151
Missouri	537,520	1,089,251	22,880	18,908	67,460	1,108,159
New York	61,700	192,924	48,610	281,520	54,000	474,444
Tennessee	998,980	4,099,237	97,610	71,108	181,870	4,170,345
Vermont	1,482,710	5,047,116	42,400	49,600	168,070	5,096,716
Other States [1]	159,150	481,838	15,230	284,627	28,700	766,465
	3,951,270	14,836,477	266,240	789,395	600,060	15,625,872
1928						
Alabama	112,580	735,452	52,840	57,389	62,400	792,841
California	(2)	(2)	(2)	(2)	2,000	69,375
Georgia	542,200	2,892,635	26,100	36,845	72,170	2,929,480
Massachusetts	32,180	157,414	1,550	2,251	4,260	159,665
Missouri	631,090	1,421,044	1,480	4,016	53,810	1,425,060
New York	57,570	162,922	41,390	204,954	46,370	367,876
Tennessee	1,236,620	4,982,247	66,350	56,170	170,660	5,038,417
Vermont	1,242,300	4,897,321	32,780	38,236	138,310	4,935,557
Other States [1]	[2] 201,150	[2] 609,561	[2] 14,410	[2] 144,529	29,510	684,715
	4,055,690	15,858,596	236,900	544,390	579,490	16,402,986

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[1] 1927: Alaska, Arizona, Arkansas, Colorado, Maryland, Nevada, New Jersey, North Carolina, Pennsylvania, Utah, Virginia, and Washington; 1928: Alaska, Arizona, Arkansas, Colorado, Maryland, New Jersey, Pennsylvania, Texas, Utah, and Washington.

[2] California included under "Other States."

SERPENTINE

The figures showing sales of serpentine (verde antique) for interior and exterior building, dimension stone, and by-products are included in the figures for marble, but those showing sales of serpentine as crushed stone for road metal, ballast, riprap, and other low-grade material are included in the figures for "miscellaneous" stone. The States represented in the production of serpentine in 1928 are California, Georgia, Maryland, Massachusetts, New Jersey, Pennsylvania, Vermont, Washington, and Wyoming.

Serpentine (verde antique) sold by producers in the United States, 1927 and 1928, by uses

Use	1927		1928	
	Quantity	Value	Quantity	Value
Building and ornamental stone cubic feet	100,000	$641,845	109,590	$854,707
Rough construction, crushed, etc short tons	22,930	94,730	53,840	104,764
	----------	736,575	----------	959,471

PRODUCING LOCALITIES—MARBLE, "ONYX," AND SERPENTINE

The locations of the marble, "onyx," and serpentine deposits in the United States reporting in 1928 and the owners or operators of these deposits, by States, are as follows:

Alabama.—Marble was produced in Alabama for commercial purposes in 1928 by the Alabama Marble Co., at Gantts Quarry, the Madras Marble Corporation, and the Moretti-Harrah Marble Co., at Sylacauga. This marble is sold for building and monumental work, with the broken stone for terrazzo, riprap, whiting substitute, and furnace flux and other crushed stone. In 1928 marble from Gantts Quarry was used for interior work in the State Bank Building, Chicago, Ill., and the First National Bank and Penobscot Building, Detroit, Mich.

Alaska.—The only marble quarries operated in Alaska are those of the Vermont Marble Co. (Proctor, Vt.) at Tokeen and Calder. The stone is shipped in rough blocks from the quarries to finishing plants and is used entirely for interior building.

Arizona.—Deposits of "onyx" marble were operated in 1928 at Cave Creek, near Phoenix, Maricopa County, by the Arizona Onyx Products Co., and at Mayer, Yavapai County, by the Yavapai Onyx Corporation. This "onyx" marble is used chiefly for gear-shift balls, lamp and inkwell bases, and gift-shop novelties, and to a smaller extent for interior building work.

Arkansas.—The marble quarries at Batesville, Independence County, Ark., are owned by the Batesville Marble Quarries Co. The White River Marble Co. produces a small amount of stone at Cartney, Baxter County, Ark.

California.—The only marble quarries in California operated in 1928 for dimension stone were those of the Columbia Marble Co. at Columbia, Tuolumne County. This stone was used in the construction of bookstacks in the State Capitol Library, Sacramento, in 1928.

In the same county the Tuolumne National Marble Co. produced marble for terrazzo and stucco from quarries at Sonora. L. Cardini, lessee of the Tolinas quarry, Suisun, Solano County, quarried some "onyx," or travertine, for use with cement in making cast stone. The Dinneen Marble Works (address, Fortieth and Grove Streets, Oakland) produced a small amount of "travertine onyx" near Bridgeport, Mono County. The property was sold in December, 1928, to the Mono Travertine Co. (address, I. W. Hellman Building, Los Angeles). It is also reported that the California Red Travertine Co. will develop a deposit of travertine near Bridgeport, Mono County, for operation in the near future.

Colorado.—The marble quarries at Marble, Gunnison County, were operated in 1928 by the Colorado Consolidated Yule Marble Co. In 1928 this stone was used for the exterior of the Huntington Mausoleum and the interior of the Sunnyside and Woodlawn Mausoleums at Los Angeles. On December 15, 1928, the property, then owned by Jacob F. Smith, was sold to the Yule Colorado Marble Co. It was reported that the Vermont Marble Co. (address, Proctor, Vt.) had acquired a half interest in the property, had taken over the management, and was operating the mill and quarry. Development work was done on other marble properties at Marble, but no stone was marketed. The United States Marble Co. (address, Temple Court, Denver) was incorporated in November, 1928, to operate marble properties near Salida, Chaffee County, and Canon City, Fremont County.

Georgia.—Marble was sold for building and monumental stone in Georgia in 1928 from the quarries of The Georgia Marble Co. at Tate, Pickens County. This company also quarried "verde antique" (serpentine) near Hollysprings, Cherokee County, and shipped a small amount of stone for interior building. Among the important recent constructions from Georgia marble are the exterior of the Bok Singing Tower, Mountain Lake, Fla., the Shedd Aquarium, Chicago, Ill., the Stephens Mausoleum, Albany, N. Y., the interior of the capitol, San Juan, Porto Rico, the Fairmount Mausoleum, Newark, N. J., and the Pasteur Monument, Chicago, Ill. The Regal Marble Corporation, of Summerville, Chattooga County, Ga., started operations in 1928. Some stone was quarried but none was marketed. The American Marble Co. (address, 140 Peachtree Street, Atlanta, Ga.) also operated property at Whitestone, Pickens County, in 1928, but all stone quarried was held for stock and none offered for sale. The Godfrey Marble Co. (address, Atlanta, Ga.) in 1928 developed the Golden Travertine quarry at Cuthbert, Randolph County, and a small amount of stone was sold for interior work.

Maryland.—The Beaver Dam Marble Co. (address, 305 Federal Street, Baltimore) quarried and sold marble for exterior building in 1928 from the quarries at Cockeysville, Baltimore County. Stone from this quarry was used recently for exterior work on the Fisher Building, Detroit, Mich. The Cockeysville stone was also sold for stucco, grit, agriculture, and other crushed-stone products. Serpentine was quarried near Cardiff, Harford County, by the Cardiff Green Marble Co. This stone was used for interior building and for terrazzo.

Massachusetts.—The Lee Marble Works is the only company now quarrying marble in Massachusetts. The quarry is at Lee, Berkshire

County, and has for many years furnished marble to the Government for marking the graves of soldiers of various wars. It is also used for exterior and interior building construction. In 1928 it was used for exterior work on the Sharon Hospital, Sharon, Conn., Pine Trade School, Ansonia, Conn., Adams Library, Adams, Mass., and for interior work in the Palace Theatre, Danbury, Conn., Fairfield Theatre, Fairfield, Conn., and Telephone Building, Glen Cove, N. Y. Serpentine was quarried in Massachusetts by the Westfield Marble Quarries (Inc.) at Westfield, Hampden County. The stone is all sold to manufacturers in rough blocks.

Missouri.—The production of stone in the Carthage marble district at Carthage, Jasper County, is shown on page 323. This is the largest marble district in Missouri, and at present the building and monumental stone quarries are operated by the Carthage Marble Corporation, successor to several individual companies formerly operating in the district. The Carthage stone has recently been used for exterior work in the Fisher Building, Detroit, Mich., Roger Bascom High School, St. Bernard, Ohio, and the Hunt County courthouse, Greenville, Tex., and for interior work in the United States post office, Coeur d'Alene, Idaho, Saline County courthouse, Wilber, Nebr., Industrial Trust Building, Providence, R. I., and Southwestern Bell Telephone Building, Dallas, Tex. The Phenix Marble Co. (address, Scarritt Building, Kansas City, Mo.) quarried marble at Phenix, Greene County, chiefly for interior work. The Joplin Marble Quarries Co., Joplin, operated quarries in Newton County near Joplin. Stone from these quarries has recently been used for exterior work in the Missouri State Highway Building, Jefferson City, Mo., Connor Hotel, Joplin, Mo., and Bethany College, Lindsborg, Kans., and for interior work in the Connor Hotel, Joplin, Mo., and the Bank of New York, New York Athletic Club, and Fuller Building, New York City. The Ozora Marble Quarries Co. (address, Paul Brown Building, St. Louis) operated marble quarries near St. Marys, Ste. Genevieve County. Stone from these quarries was used in 1928 for interior work in the Fisher Building, Detroit, Mich., and the capitol at Harrisburg, Pa.

Montana.—Considerable development work was done on marble deposits in the neighborhood of Townsend, Broadwater County, Mont., in 1928 by the Vermont Marble Co. (address, Proctor, Vt.), but no marble was marketed from this point.

New Jersey.—Rock Products Co. (address, Easton, Pa.) produced serpentine for construction and terrazzo from the Lizzie Clay & Pulp Co. quarry at Phillipsburg, Warren County.

New York.—The marble sold in 1928 from quarries in New York State was produced by the following companies:

Clinton County:
  Bluff Point—Vermont Marble Co. (address, Proctor, Vt.); for interior building.
  Plattsburg—Day Quarry Co.; stone sold in rough blocks for exterior building.
Dutchess County: Wingdale—South Dover Marble Co. (address, One hundred and thirty-third Street and Walnut Avenue, New York City); stone quarried and shipped in rough blocks for exterior construction. Marble from this quarry was recently used for Stamford Trust Co. Building, Stamford, Conn., Orange Presbyterian Church, Orange, N. J., Southampton Hospital, Southampton, N. Y., and addition to Savoy-Plaza Hotel, New York City.

St. Lawrence County:
  Gouverneur—
    DeKalb White Marble Co.; marble from this quarry was used in 1928 for stucco and the manufacture of cast stone.
    Gouverneur Marble Co.; marble from this quarry was used in 1928 in the construction of St. Peter's Roman Catholic Church, Lowville, N. Y., and the County Clerk's Building, Canton, N. Y.
Westchester County:
  Tuckahoe—
    Benedict Stone Co. (address, 420 Lexington Avenue, New York City); stone crushed and sold for manufacture of cast and artificial stone, stucco, etc.
    Conlin Marble Co. (Inc.); product all sold as crushed or pulverized stone for terrazzo and stucco, as marble dust and flour, and for various other purposes.
    Kapailo Manufacturing Co. (address, Pershing Square Building, New York City); product crushed and sold for manufacture of cast and artificial stone, stucco, poultry grit, etc.

North Carolina.—No marble was produced in North Carolina in 1928, although development work on both new and old quarries was reported.

Pennsylvania.—In 1928 H. L. McLinans operated the marble quarry near West Grove, Chester County, formerly operated by the Penn Marble & Granite Co. Serpentine was quarried by Jos. H. Brinton, near West Chester, Chester County, for rough construction; by the Octoraro Stone Co. (address, Nottingham), near Wrightsdale, Lancaster County, for stucco, terrazzo, and road work; and by the Rock Products Co. from the "Sylvan Green" quarry, near Easton, Northampton County, for interior building.

Tennessee.—Marble quarries in Blount, Knox, Lincoln, and Union Counties in Tennessee were operated in 1928 by the following:

Blount County:
  Friendsville—John J. Craig Co. (address, Knoxville); Craig quarry.
  Kiser—Andres Stone & Marble Co. (address, Milwaukee, Wis.).
  Louisville—Light Pink Marble Co.; "Anderson Pink" quarry.
Knox County:
  Knoxville—
    Appalachian Marble Co.
    Bond Marble Co.; "Bond Pink" quarry.
    John J. Craig Co.; Boyd quarry.
    Gray Knox Marble Co.; Gray Knox, Consolidated, and Asbury quarries. Stone from these quarries has recently been used in the interior of The Fidelity Trust Co., Philadelphia, Pa.
    Knoxville-Gray Eagle Marble Co. (successor to Knoxville Marble Co. and Gray Eagle Marble Co.).
    Le Conte Marble Co. (address, Johnson City, Tenn.)(successor to the Farragut Marble Co.).
    Ross & Republic Marble Co.; Ross quarry. Stone from this quarry was used in 1928 for exterior and interior work on the administration building of the board of education, Pittsburgh, Pa.
    Tennessee Producers Marble Co.; Gray quarry.
Lincoln County: Brighton—Tennessee Marble & Brick Co. (address, Fayetteville)(successor to National Marble Co.); stone sold as mill blocks, terrazzo, and marble meal or stucco.
Loudon County: Lenoir City—Diamond Marble Co. (address, Friendsville) (successor to the Tripoli Marble Co.).
Union County:
  Luttrell—
    Knoxville-Gray Eagle Marble Co. (address, Knoxville) (successor to the Knoxville Marble Co. and Gray Eagle Marble Co.).
    Ross & Republic Marble Co. (address, Knoxville); Republic quarry.

Texas.—The marble deposit owned by the Jordan Marble Co., near Alpine, Brewster County, Tex., was leased and operated in 1928 by the Marble Mountain Co. (Inc.) (address, Broadway Central Building, Los Angeles, Calif.). The work done at the quarry was chiefly development and construction work; a small amount of stone, however, was shipped and used for exterior construction.

Utah.—The only marble quarry operated commercially for construction in Utah in 1928 was the "Bird's-eye" quarry, at Thistle, Utah County, of the Mount Nebo Marble Co. It was operated by Andrew & Reimann, lessees (address, Salt Lake City). Stone from this quarry was used for interior work in the First National Bank Building, Canon City, Colo., and the Cache Valley Bank Building, Logan, Utah. The Rainbow Quarry Co. (address, 1014 Third Avenue, Salt Lake City) operated a marble property near Mills, Juab County, in 1928. Except for samples the material quarried was crushed for roofing granules.

Vermont.—Vermont ranks first in the production of high-grade marble for monumental and building work. Stone for terrazzo, stucco, paper mills, and other industrial uses is also furnished by the marble quarries. The following firms operate marble quarries in Vermont:

Franklin County: Swanton—Vermont Marble Co. (address, Proctor); "Champlain Red" marble for interior work produced at this quarry.
Grand Isle County: Isle La Motte—Vermont Marble Co. (address, Proctor); black marble for interior work produced at this quarry; much of the product shipped to mills of this company at Proctor for finishing.
Rutland County:
  Brandon, Danby, Pittsford, Proctor, and West Rutland—Vermont Marble Co. (address, Proctor); marble for exterior and interior building, monuments, and mausoleums shipped from these quarries; greater part of the stone sold from the mills at Proctor as sawed or finished stone. Stone from the other quarries of this company also milled at Proctor and sold from there.
  Pittsford—Venetian Co. (address, Rutland); rough blocks for monumental work produced in 1928.
  West Rutland—
    Colonial Marble Corporation (address, West Rutland); stone furnished in 1928 for interior work in 333 North Michigan Avenue Building, Chicago, Ill., Westminster Abbey Mausoleum, Pittsburgh, Pa., and Tod Homestead Mausoleum, Youngstown, Ohio.
    Green Mountain Marble Corporation (successor to Clarendon Marble Co.); rough stone and dressed stone for exterior and interior building, mausoleums, and monuments sold from the quarries and mills of this company. In 1928 stone from this quarry furnished for Prentice residence, Williamstown, Mass., and the interior of the Post Office Building, Syracuse, N. Y.
Washington County: Roxbury—Vermont Marble Co. (address, Proctor); serpentine (verde antique) produced at this quarry and sold in rough blocks; also shipped to mills of the company, milled, and sold as finished stone.
Windsor County: Rochester—Vermont Marble Co. (address, Proctor); serpentine (verde antique) produced at this quarry and sold in rough blocks; also shipped to mills of the company, milled, and sold as finished stone.

Virginia.—The quarries of black marble owned by the Rockingham Marble Corporation (successor to the American Black Marble Corporation) (address, 49 West Forty-fifth Street, New York City), at Harrisonburg, Rockingham County, started operations in August, 1928, but no stone was marketed.

Washington.—Deposits of serpentine near Chewelah and Valley, Stevens County, are operated intermittently for terrazzo, stucco, cast stone, etc. In 1928 J. J. Schoenberg, Chewelah; the Manufacturers Mineral Co., 1107 West Idaho Street, Seattle; and J. J. McGrath, Valley, reported sales of stone for these uses.

LIMESTONE

The production of limestone in 1928, as covered by the figures given in this report, amounted to 96,864,650 short tons, valued at $110,231,974, which was 3 per cent less in quantity and 2 per cent less in value than in 1927. Crushed stone for road metal, concrete, and railroad ballast, which represented 63 per cent of the total limestone production, decreased 6 per cent in both quantity and value. Crushed stone used for railroad ballast increased 5 per cent and that for concrete and road metal decreased 9 per cent in quantity. Fluxing stone, the next largest limestone product, increased 7 per cent in quantity, and limestone for construction increased 2 per cent. There was also an increase in stone for curbing and other street work, rubble, sugar factories, glass factories, and other miscellaneous uses.

Limestone sold or used by producers in the United States, 1927 and 1928, by uses

Use	1927		1928	
	Quantity	Value	Quantity	Value
Building stone [1] .... cubic feet..	17, 340, 690	$18, 820, 045	17, 641, 370	$20, 193, 963
Approximate equivalent in short tons	1, 278, 620	....	1, 370, 940	....
Curbing, flagging, and paving ...... cubic feet..	223, 370	134, 360	322, 560	205, 724
Approximate equivalent in short tons	18, 670	....	34, 400	....
Rubble .... short tons..	226, 280	400, 790	365, 920	705, 723
Riprap .... do....	2, 185, 380	2, 119, 557	1, 822, 340	1, 765, 147
Crushed stone .... do....	65, 080, 400	63, 411, 465	60, 952, 500	59, 294, 147
Fluxing stone .... do....	21, 660, 820	15, 977, 484	23, 094, 090	16, 929, 986
Sugar factories .... do....	483, 800	881, 370	487, 060	851, 850
Glass factories .... do....	247, 210	420, 415	281, 260	441, 906
Paper mills .... do....	289, 010	436, 204	155, 050	290, 590
Agriculture .... do....	2, 206, 470	3, 360, 704	2, 186, 870	3, 153, 848
Other uses [2] .... do....	5, 985, 610	6, 477, 430	6, 114, 220	6, 399, 090
Total (quantities approximate, in short tons)	99, 662, 270	112, 439, 824	96, 864, 650	110, 231, 974

[1] Figures for building stone include small amounts of monumental stone.
[2] See table on p. 319 for further distribution of limestone products.

Ohio produced more limestone than any other State in 1928, followed closely by Pennsylvania. Michigan and New York are the next largest producers. Indiana ranks first in the value of its limestone production on account of its output of high-grade building stone. The following table shows the production of the different States.

Limestone sold or used by producers in the United States, 1927 and 1928, by States

[Quantities approximate]

State	1927		1928	
	Short tons	Value	Short tons	Value
Alabama	1, 164, 130	$1, 079, 137	1, 167, 830	$1, 368, 315
Arizona	(1)	(1)	84, 740	71, 980
Arkansas	67, 760	82, 128	19, 520	17, 618
California	231, 640	503, 890	224, 550	534, 467
Colorado	651, 550	681, 742	595, 530	563, 215
Connecticut	29, 260	53, 340	30, 910	113, 208
Florida	7, 137, 230	5, 895, 857	3, 368, 600	2, 624, 493
Georgia	199, 730	350, 097	540, 060	649, 514
Hawaii	--------------	--------------	(1)	(1)
Idaho	28, 150	77, 376	29, 650	67, 634
Illinois	9, 650, 270	8, 095, 086	9, 645, 370	8, 050, 429
Indiana	5, 803, 860	22, 621, 976	5, 102, 280	22, 720, 411
Iowa	1, 274, 380	1, 231, 546	1, 666, 270	1, 742, 252
Kansas	787, 770	895, 030	1, 203, 270	1, 212, 598
Kentucky	2, 426, 250	2, 615, 622	2, 676, 370	2, 822, 280
Louisiana	115, 450	169, 643	(1)	(1)
Maine	122, 070	188, 852	92, 100	148, 253
Maryland	310, 550	403, 875	284, 350	421, 355
Massachusetts	92, 100	355, 771	106, 880	329, 231
Michigan	11, 335, 780	6, 243, 751	12, 381, 240	7, 407, 149
Minnesota	463, 070	1, 009, 702	313, 700	710, 478
Mississippi	(1)	(1)	(1)	(1)
Missouri	2, 975, 710	3, 972, 567	3, 277, 800	4, 476, 135
Montana	146, 230	131, 994	105, 770	113, 777
Nebraska	170, 500	332, 222	234, 590	399, 971
Nevada	(1)	(1)	(1)	(1)
New Jersey	233, 550	388, 551	163, 490	336, 908
New York	10, 380, 640	13, 401, 838	10, 431, 170	13, 139, 230
North Carolina	242, 490	316, 356	225, 460	274, 431
Ohio	15, 126, 450	13, 006, 789	13, 235, 780	10, 903, 862
Oklahoma	1, 688, 500	1, 371, 310	1, 928, 590	1, 570, 824
Oregon	(1)	(1)	15, 030	29, 714
Pennsylvania	12, 382, 070	13, 025, 863	13, 048, 120	13, 075, 166
Porto Rico	113, 780	209, 476	79, 730	136, 341
Rhode Island	(1)	(1)	(1)	(1)
South Dakota	32, 360	34, 261	60, 940	77, 358
Tennessee	1, 959, 990	2, 246, 319	2, 164, 870	2, 250, 249
Texas	3, 101, 400	2, 217, 559	2, 767, 230	2, 008, 387
Utah	618, 290	419, 844	656, 820	443, 336
Vermont	42, 130	137, 128	45, 550	151, 515
Virginia	2, 499, 710	2, 539, 196	2, 383, 310	2, 442, 046
Washington	57, 630	94, 162	61, 030	97, 145
West Virginia	3, 108, 450	2, 876, 975	3, 139, 040	2, 898, 234
Wisconsin	2, 523, 990	2, 588, 527	2, 655, 100	3, 058, 567
Wyoming	253, 230	431, 104	267, 730	430, 975
Undistributed	114, 170	143, 362	384, 280	342, 923
	99, 662, 270	112, 439, 824	96, 864, 650	110, 231, 974

[1] Included under "Undistributed."

Limestone sold or used by producers in the United States in 1928, by States and uses

State	Number of active plants	Building[1]						Rubble		Riprap		Crushed stone			
		Rough construction		Rough architectural		Finished (sawed and cut)						Concrete and road metal		Railroad ballast	
		Short tons	Value	Cubic feet	Value	Cubic feet	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Alabama	11			(2)	(2)	(2)	(2)			32, 220	$22, 969	79, 370	$74, 267	162, 670	$77, 333
Arizona	3											14, 410	18, 982		
Arkansas	2											19, 520	17, 618		
California	17	(2)	(2)									33, 070	33, 394	(2)	(2)
Colorado	17			4, 230	$6, 346							(2)	(2)	(2)	(2)
Connecticut	5											(2)	(2)		
Florida	34	(2)	(2)							14, 620	25, 117	2. 959, 810	2, 235, 217	379, 230	356, 950
Georgia	9											460, 110	448, 203	6, 100	4, 500
Hawaii	1														
Idaho	3														
Illinois	70	(2)	(2)			(2)	(2)	8, 110	$12, 430	203, 460	169, 384	6, 726, 810	5, 693, 703	1, 367, 430	812, 586
Indiana	75			4, 534, 950	2, 705, 244	10, 383, 010	$16,045,098	4, 110	3, 518	121, 690	37, 397	3, 118, 310	3, 273, 147	327, 720	275, 481
Iowa	35	8, 750	$13, 000					3, 800	3, 985	106, 790	87, 586	1, 199, 230	1, 306, 984	112, 040	109, 160
Kansas	44	30, 590	60, 371	(2)	(2)	16, 890	11, 970	14, 920	13, 073	56, 610	69, 870	659, 630	665, 669	420, 360	361, 413
Kentucky	83	640	1, 411	116, 180	82, 648			4, 280	10, 103	96, 350	82, 490	1, 598, 450	1, 939, 983	877, 080	586, 557
Louisiana	1									(2)	(2)	(2)	(2)	(2)	(2)
Maine	3	(2)	(2)									(2)	(2)		
Maryland	18	12, 650	17, 695									249, 830	330, 570	13, 110	18, 542
Massachusetts	9	(2)	(2)					(2)	(2)			(2)	(2)		
Michigan	19											1, 445, 000	1, 079, 734	271, 190	199, 879
Minnesota	21	(2)	(2)	121, 010	136, 026	76, 600	233, 465	7, 270	14, 272	37, 010	25, 584	231, 000	262, 108		
Mississippi	3													(2)	(2)
Missouri	106	650	1, 405	470	308	27, 940	25, 152	276, 020	504, 672	694, 530	843, 106	1, 940, 570	2, 531, 038	155, 800	165, 227
Montana	7									420	840	35, 440	34, 853		
Nebraska	5									40, 690	35, 282	(2)	(2)	(2)	(2)
Nevada	2														
New Jersey	4											40, 140	52, 259		
New York	71	25, 230	23, 021			(2)	(2)	(2)	(2)	88, 760	77, 306	7, 843, 680	10, 324, 389	1, 257, 250	1, 124, 015
North Carolina	4											187, 300	202, 341		
Ohio	110	7, 590	13, 184					12, 560	23, 158	19, 300	13, 751	7, 762, 990	6, 678, 237	1, 449, 560	1, 201, 664
Oklahoma	15	(2)	(2)					(2)	(2)	16, 450	14, 159	1, 035, 070	941, 293	837, 170	580, 605
Oregon	3													(2)	(2)
Pennsylvania	233	80, 700	101, 196							2, 700	2, 700	4, 883, 090	5, 901, 807	74, 560	81, 590
Porto Rico	14	7, 230	11, 988					(2)	(2)			66, 150	92, 308		
Rhode Island	1														
South Dakota	10	(2)	(2)									53, 320	67, 053		
Tennessee	32							2, 550	2. 116	7, 030	4, 540	1, 070, 280	1, 121, 183	894, 660	692, 769

Texas	26	4, 200	4, 049	97, 060	45, 000			(²)	(²)	24, 880	25, 455	1, 260, 950	1, 031, 584	1, 396, 170	844, 402
Utah	14			(²)	(²)					163, 100	87, 701			288, 510	160, 624
Vermont	7											26, 300	54, 933		
Virginia	77	(²)	(²)							(²)	(²)	1, 156, 230	1, 192, 722	697, 550	620, 937
Washington	6									(²)	(²)				
West Virginia	20											287, 770	304, 706	409, 380	271, 653
Wisconsin	97	(²)	(²)	219, 610	113, 806	16, 690	48, 469	25, 390	108, 926	35, 800	50, 818	2, 368, 330	2, 281, 930	34, 710	27, 768
Wyoming	11	(²)	(²)							(²)	(²)	(²)	(²)	(²)	(²)
Undistributed		33, 550	32, 114	162, 180	178, 762	134, 050	282, 235	6, 910	9, 470	59, 900	89, 092	232, 960	298, 152	444, 530	230, 122
	1, 358	211, 780	279, 434	5, 255, 690	3, 268, 140	10, 655, 180	16, 646, 389	365, 920	705, 723	1, 822, 340	1, 765, 147	49, 075, 720	50, 490, 370	11, 876, 780	8, 803, 777

State	Fluxing stone		Sugar factories		Glass factories		Paper mills		Agriculture		Other uses		Total	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons (approximate)	Value
Alabama	840, 740	$701, 970							(²)	(²)	(²)	(²)	1, 167, 830	$1, 368, 315
Arizona	70, 330	52, 998											84, 740	71, 980
Arkansas													19, 520	17, 618
California	22, 000	47, 123	23, 440	$72, 869	(²)	(²)	(²)	(²)	13, 360	$39, 592	119, 430	$307, 696	224, 550	534, 467
Colorado	338, 350	313, 434	50, 350	82, 963							(²)	(²)	595, 530	563, 215
Connecticut	(²)	(²)							(²)	(²)	(²)	(²)	30, 910	113, 208
Florida									(²)	(²)	(²)	(²)	3, 368, 000	2, 624, 493
Georgia									30, 760	46, 529	43, 090	150, 279	540, 000	649, 514
Hawaii									(²)	(²)			(²)	(²)
Idaho	(²)	(²)	(²)	(²)			(²)	(²)	(²)	(²)	(²)	(²)	29, 650	67, 634
Illinois	675, 270	642, 406			20, 020	$17, 690			565, 000	511, 005	71, 260	178, 740	9, 645, 370	8, 050, 429
Indiana	158, 290	23, 622			(²)	(²)			181, 160	190, 402	(²)	(²)	5, 102, 280	22, 720, 411
Iowa	6, 840	9, 767	(²)	(²)					207, 660	180, 770	(²)	(²)	1, 666, 270	1, 742, 252
Kansas									16, 280	17, 258	(²)	(²)	1, 203, 270	1, 212, 598
Kentucky	20, 560	16, 124							51, 410	56, 508	19, 230	46, 456	2, 676, 370	2, 822, 280
Louisiana													(²)	(²)
Maine	(²)	(²)					(²)	(²)	120	805			92, 100	148, 253
Maryland	(²)	(²)							(²)	(²)	(²)	(²)	284, 350	421, 355
Massachusetts	13, 630	19, 639					(²)	(²)	44, 210	202, 832	31, 820	63, 904	106, 880	329, 231
Michigan	7, 289, 490	4, 156, 908	(²)	(²)	(²)	(²)	(²)	(²)	199, 980	195, 184	3, 129, 870	1, 713, 096	12, 381, 240	7, 407, 149
Minnesota	(²)	(²)							19, 870	19, 492	(²)	(²)	313, 700	710, 478
Mississippi									(²)	(²)			(²)	(²)
Missouri	16, 260	18, 697	4, 420	3, 965	19, 200	34, 329			87, 740	102, 028	80, 280	246, 208	3, 277, 800	4, 476, 135
Montana	50, 610	43, 468	19, 300	34, 616									105, 770	113, 777
Nebraska	(²)	(²)			(²)	(²)			(²)	(²)	54, 870	217, 989	234, 590	399, 971
Nevada	(²)	(²)	(²)	(²)							(²)	(²)	(²)	(²)
New Jersey	(²)	(²)							23, 770	70, 200	(²)	(²)	163, 490	336, 908
New York	145, 190	136, 170					25, 200	$53, 353	88, 060	281, 283	955, 080	1, 077, 583	10, 431, 170	13, 139, 230
North Carolina	(²)	(²)							(²)	(²)	(²)	(²)	225, 460	274, 431

[1] Figures for building stone include small amounts for monumental work.

[2] Included under "Undistributed."

Limestone sold or used by producers in the United States in 1928, by States and uses—Continued

State	Fluxing stone		Sugar factories		Glass factories		Paper mills		Agriculture		Other uses		Total	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons (approximate)	Value
Ohio	3, 274, 090	$2, 185, 820	(2)	(2)	36, 700	$57, 001	(2)	(2)	199, 190	$233, 031	468, 580	$491, 962	13, 235, 780	$10, 903, 862
Oklahoma									(2)	(2)	(2)	(2)	1, 928, 590	1, 570, 824
Oregon							(2)	(2)	(2)	(2)			15, 030	29, 714
Pennsylvania	7, 459, 710	5, 991, 367			105, 230	179, 914	30, 560	$35, 400	55, 470	182, 624	356, 100	598, 568	13, 048, 120	13, 075, 166
Porto Rico									5, 470	31, 132	(2)	(2)	79, 730	136, 341
Rhode Island	(2)	(2)											(2)	(2)
South Dakota			(2)	(2)					(2)	(2)	(2)	(2)	60, 940	77, 358
Tennessee	15, 860	17, 534							117, 800	230, 577	56, 660	181, 530	2, 164, 870	2, 250, 249
Texas	23, 750	23, 795			(2)	(2)			(2)	(2)	47, 960	31, 252	2, 767, 230	2, 008, 387
Utah	170, 930	142, 964	30, 700	$37, 447							(2)	(2)	656, 820	443, 336
Vermont	(2)	(2)							(2)	(2)	6, 200	39, 696	45, 550	151, 515
Virginia	111, 640	115, 613					(2)	(2)	92, 250	157, 947	315, 590	342, 980	2, 383, 310	2, 442, 046
Washington	18, 480	18, 288	(2)	(2)			39, 320	68, 005	(2)	(2)	(2)	(2)	61, 030	97, 145
West Virginia	2, 290, 580	2, 154, 077			(2)	(2)			20, 630	45, 951	(2)	(2)	3, 139, 040	2, 898, 234
Wisconsin	(2)	(2)							76, 290	142, 189	84, 680	275, 834	2, 655, 100	3, 058, 567
Wyoming	(2)	(2)	231, 800	420, 330									267, 730	430, 975
Undistributed	81, 490	98, 202	127, 050	199, 660	100, 110	152, 972	59, 970	133, 832	90, 380	216, 479	307, 920	641, 041	384, 280	342, 923
	23, 094, 090	16, 929, 986	487, 060	851, 850	281, 260	441, 906	155, 050	290, 590	2, 186, 870	3, 153, 848	6, 148, 620	6, 604, 814	96, 864, 650	110, 231, 974

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[2] Included under "Undistributed."

Limestone sold or used by producers in the United States for miscellaneous uses, 1927 and 1928

Use	1927		1928	
	Short tons	Value	Short tons	Value
Alkali works	3, 848, 490	$2, 449. 284	4, 231, 750	$2, 585, 216
Asphalt filler	420, 860	1, 343, 987	407, 350	1, 284, 983
Calcium carbide works	316, 960	164, 875	282, 610	178, 902
Carbonic acid works	8, 860	7, 566	4, 690	10, 899
Coal mine dusting	28, 410	91, 495	54, 460	140, 023
Filter beds	271, 800	272, 834	41, 230	63, 715
Magnesia works (dolomite)	69, 940	115, 932	94, 200	122, 260
Mineral food	30, 470	80, 274	39, 460	180, 662
Mineral (rock) wool	15, 390	12, 962	31, 700	27, 042
Poultry grit	33, 350	198, 144	18, 110	137, 479
Refractory stone (dolomite)	434, 160	424, 140	522, 850	509, 502
Road base	198, 660	236, 317	11, 500	6, 900
Roofing gravel	5, 620	6, 658	5, 950	12, 717
Stucco, terrazzo, and artificial stone	98, 180	348, 797	77, 850	354, 145
Whiting substitute	124, 840	551, 915	95, 400	442, 742
Other uses [1]	79, 620	172, 250	195, 110	341, 903
	5, 985, 610	6, 477, 430	6, 114, 220	6, 399, 090

[1] Includes stone for ammonia, baking powder, lime burners, nitrates, phosphates, powder, purification of copper, reduction of aluminum ore, soap, sulphuric acid, and uses not specified.

A considerable quantity of the limestone reported in the tables by uses is burned into lime—particularly the limestone reported by iron and steel producers and by alkali, sugar, and paper manufacturers as quarried by them and used in their own plants; also limestone sold to manufacturers of these and other commodities, who may burn it into lime before using it. To avoid duplication, this lime is not included in the figures of production in the chapter on lime. Limestone manufactured into lime and into cement and reported in terms of finished product is treated in separate chapters. The quantities so used are estimated in the following table.

Limestone used for all purposes in the United States, 1924–1928, in short tons

Use	1924	1925	1926	1927	1928
Limestone (as given in this report)	75, 894, 430	85, 649, 440	91, 887, 900	99, 662, 270	96, 864, 650
Portland cement (including "cement rock")	37, 727, 000	40, 720, 000	41, 583, 000	43, 800, 000	44, 600, 000
Natural cement ("cement rock")	236, 000	292, 000	391, 000	395, 000	412, 000
Lime	8, 144, 000	9, 100, 000	9, 121, 000	8, 830, 000	8, 920, 000
	122, 001, 430	135, 761, 440	142, 982, 900	152, 687, 270	150, 796, 650

BUILDING STONE

Of the total quantity of building stone reported in 1928, 57 per cent (17,641,370 cubic feet) was limestone, which increased 2 per cent in quantity over 1927. The high-grade limestone classed as architectural building stone is obtained from a few well-known localities. Such figures as are available covering the output of these districts for a series of years are given in the following tables.

Alabama.—Oolitic limestone used as high-grade building stone is quarried at Rockwood, near Russellville. Figures for the output of this district in 1927 and 1928 are included in the total sales of limestone but may not be published separately. Besides being used as building stone, this limestone is sold for flux, riprap, rubble, agricultural limestone, and for other purposes.

Limestone sold by producers at Russellville, Franklin County, Ala., 1919–1928

Year	Construction (rough and dressed)		Other		Total	
	Cubic feet	Value	Short tons	Value	Short tons (approximate)	Value
1919	27,000	$41,000	110,000	$106,000	112,000	$147,000
1920	25,300	25,291	143,000	162,643	145,000	187,934
1921	50,500	55,530	15,000	15,533	19,000	71,063
1922	50,000	56,845	97,000	72,101	101,000	128,946
1923	60,000	54,000	184,800	148,500	189,600	202,500
1924	45,520	78,987	96,560	76,505	100,000	155,492
1925	145,510	129,116	156,610	128,842	168,000	257,958
1926	135,600	129,448	137,200	124,589	148,400	254,037
1927–28	(1)	(1)	(1)	(1)	(1)	(1)

(1) Bureau of Mines not at liberty to publish figures.

Indiana.—The largest quarry center for building stone in the United States is the oolitic limestone district near Bedford, Lawrence County, and Bloomington, Monroe County, Ind. In 1928 the output of building stone in this district increased 7 per cent in quantity and 8 per cent in value over 1927. The quarry operators in the district in 1928 and their addresses were as follows:

Heltonville Limestone Co., Indiana Limestone Co., Ingalls Stone Co., and Reed-Powers Cut Stone Co., Bedford; Bloomington Limestone Co., Empire Stone Co., B. G. Hoadley Quarries (Inc.), Hoadley Bros. (Inc.), Hunter Bros. Stone Co., Independent Limestone Co., Indiana Oolitic Limestone Co., Indian Hill Stone Co., Alexander King Stone Co., Monon Stone Co., Sare-Hoadley Stone Co., Shawnee Stone Co., and H. A. Woolery & Son, Bloomington; Bloomington & Ellettsville Stone Co. and Perry Stone Co., Ellettsville; Indianapolis Oolitic Stone Co., Stinesville; and Victor Oolitic Stone Co., Victor.

Other companies reported the development of quarries, with the prospect of production in 1929.

Limestone sold by producers in the Bedford-Bloomington district, Lawrence and Monroe Counties, Ind., 1919–1928

Year	Construction		Other		Total	
	Cubic feet	Value	Short ton	Value	Short tons (approximate)	Value
1919	4,788,639	$3,787,151	174,463	$159,181	522,000	$3,946,332
1920	6,343,536	7,286,679	278,235	293,200	738,000	7,579,879
1921	5,297,458	6,815,859	141,068	146,425	525,000	6,962,284
1922	9,616,670	11,288,823	214,722	139,233	912,000	11,428,056
1923	11,694,380	15,248,164	233,180	167,845	1,081,080	15,416,009
1924	11,005,570	14,164,241	255,930	200,512	1,053,730	14,364,753
1925	11,803,890	14,203,120	290,990	170,772	1,146,790	14,373,892
1926	14,171,490	18,063,148	405,630	354,703	1,432,480	18,417,851
1927	13,572,950	16,407,170	423,320	381,455	1,407,360	16,788,625
1928	14,520,260	17,760,622	429,890	302,819	1,482,610	18,063,441

Limestone sold by producers in the Bedford-Bloomington district, Lawrence and Monroe Counties, Ind., 1927 and 1928, by classes

Class	1927		1928	
	Quantity	Value	Quantity	Value
Construction:				
Rough blocks ---- cubic feet	5, 445, 970	$3, 461, 369	4, 520, 320	$2, 696, 376
Sawed ---- do	5, 268, 060	4, 685, 844	5, 745, 020	4, 128, 388
Semifinished ---- do			180, 050	353, 633
Cut ---- do	2, 858, 920	8, 259, 957	4, 074, 870	10, 582, 225
Total construction ---- do	13, 572, 950	16, 407, 170	14, 520, 260	17, 760, 622
Other stone ---- short tons	423, 320	381, 455	429, 890	302, 819
Grand total (quantities approximate, in short tons)	1, 407, 360	16, 788, 625	1, 482, 610	18, 063, 441

In recent years consolidations of firms operating quarries with those operating mills in this district have tended to decrease the sales by the quarrymen of rough blocks by throwing the rough stock quarried by them into their own mills and thereby increasing their sales of finished stone.

In 1926 the Indiana Limestone Co. was formed by the consolidation of numerous quarries and mills; in January, 1928, the Bloomington Limestone Co. was formed by the union of different quarry companies and mills; and in 1928 the Shawnee Stone Co. obtained the mill of the Central Oolitic Stone Co.

Other quarries in Indiana operated in 1928 for building stone were those of the St. Paul Stone Quarries Co., St. Paul, Decatur County, and the Ingalls Stone Co., Romona, Owen County.

The mills of the Bedford-Bloomington district, operating in 1928 on stone purchased from quarry operators, and their addresses were as follows:

Bedford Cut Stone Co., The Edward Edinger Co., The Carl Furst Co., and J. P. Falt Co., Bedford; Matthews Bros. Co., Mutual Oolitic Stone Co., and Walker Bros. Stone Co., Bloomington; Ellettsville Stone Co., Harding & Cogswell (Inc.), and A. J. Thompson Stone Co., Ellettsville; and Swenson Stone Co., Stinesville.

A considerable amount of stone is sold by the quarry operators to the finishing mills of the district. The dressed stone sold by these mills is shown in the following tables.

Indiana oolitic limestone sold by mills not operated by quarry companies in the Bedford-Bloomington district, Lawrence and Monroe Counties, Ind., 1919–1928 [1]

Year	Cubic feet	Value	Year	Cubic feet	Value
1919	686, 712	$1, 156, 168	1924	1, 754, 500	$4, 654, 145
1920	836, 298	2, 112, 384	1925	2, 087, 860	5, 629, 269
1921	1, 030, 177	2, 691, 931	1926	1, 511, 250	4, 073, 271
1922	1, 508, 100	3, 706, 900	1927	1. 670, 470	3, 646, 445
1923	1, 676, 500	4, 805, 537	1928	1, 177, 320	2, 594, 224

[1] Includes some stone purchased by quarry operators and milled and resold.

Indiana oolitic limestone sold by mills not operated by quarry companies in the Bedford-Bloomington district, Lawrence and Monroe Counties, Ind., 1927 and 1928, by classes [1]

Year	Sawed		Semifinished		Cut		Total	
	Cubic feet	Value	Cubic feet	Value	Cubic feet	Value	Cubic feet	Value
1927	728, 000	$704, 732	35, 030	$58, 056	907, 440	$2, 883, 657	1, 670, 470	$3, 646, 445
1928	322, 645	284, 034	31, 750	50, 526	822, 925	2, 259, 664	1, 177, 320	2, 594, 224

[1] Includes some stone purchased by quarry operators and milled and resold.

Kentucky.—The oolitic limestone quarried at Bowling Green, Warren County, Ky., is well known to the trade. It is quarried for building and monumental stone by the Bowling Green Quarries Co. and by William Murphy. There are also several quarries in the vicinity operated for crushed stone. The following table shows the production of the county for the last 10 years.

Limestone sold by producers in Warren County, Ky., 1919–1928

Year	Building and monumental stone (rough and dressed)		Other		Total	
	Cubic feet	Value	Short tons	Value	Short tons (approximate)	Value
1919	108, 320	$100, 817	7, 540	$10, 732	16, 500	$111, 549
1920	98, 700	123, 010	7, 480	12, 420	15, 600	135, 430
1921	128, 000	170, 540	6, 230	5, 840	16, 800	176, 380
1922	91, 400	143, 012	5, 200	7, 000	12, 740	150, 012
1923	65, 980	113, 040	24, 380	28, 915	29, 660	141, 955
1924	65, 630	120, 882	10, 000	10, 000	14, 920	130, 882
1925	128, 700	226, 646	27, 200	61, 260	37, 500	287, 906
1926	[1] 134, 460	[1] 63, 458	10, 340	10, 130	21, 000	73, 588
1927	[1] 198, 770	[1] 119, 054	73, 350	86, 400	87, 660	205, 454
1928	[1] 116, 180	[1] 82, 648	52, 920	80, 896	61, 290	163, 544

[1] Rough blocks only.

Minnesota.—The following table shows the sales of limestone at Mankato and Kasota, Minn., for the last 10 years.

Limestone sold by producers at Mankato and Kasota, Minn., 1919–1928

Year	Building stone (rough and dressed)		Other		Total	
	Cubic feet	Value	Short tons	Value	Short tons (approximate)	Value
1919	57, 959	$108, 250	46, 131	$60, 007	50, 760	$168, 257
1920	104, 865	132, 170	39, 564	54, 485	47, 900	186, 655
1921	111, 487	271, 230	32, 627	41, 409	41, 500	312, 639
1922	151, 110	261, 275	29, 910	32, 329	42, 600	293, 604
1923	138, 890	312, 911	33, 980	34, 867	44, 900	347, 778
1924	130, 660	495, 036	46, 610	43, 152	65, 560	538, 188
1925	320, 050	586, 451	66, 060	60, 179	91, 380	646, 630
1926	245, 330	638, 284	58, 050	32, 655	77, 410	670, 939
1927	199, 640	414, 350	41, 990	26, 766	57, 760	441, 116
1928	184, 610	339, 291	30, 900	19, 850	45, 560	359, 141

T. R. Coughlan Co. and Fowler & Pay, Mankato, and Babcock & Willcox and Breen Stone & Marble Co., Kasota, are the producers of the Mankato and Kasota stone. The Mantorville Stone Co. (idle in 1928), Mantorville, and the Biesanz Stone Co. and George Haun Stone Co., Winona, also furnish architectural building stone.

Missouri.—The stone quarried at Carthage, Jasper County, Mo., used for architectural building and monumental stone is classed as marble and is included in the figures of production of marble in Missouri given on page 308. Its chief use is, however, as is that of the Indiana stone, mainly for exterior building, and the figures of production are given here for convenience in comparison. The crushed stone and low-grade material are included under limestone, but all grades are combined to show the total production.

In March, 1927, the principal quarrying companies producing dimension stone were consolidated, forming the Carthage Marble Corporation, Carthage. The crushing plants are operated independently.

Limestone and marble sold by producers in the Carthage district, Jasper County, Mo., 1919–1928

Year	Building stone (rough and dressed)		Monumental stone (rough and dressed)		Other		Total	
	Cubic feet	Value	Cubic feet	Value	Short tons	Value	Short tons (approximate)	Value
1919	231, 573	$399, 381	62, 482	$77, 117	44, 817	$84, 025	69, 500	$560, 523
1920	295, 341	589, 213	86, 791	158, 440	56, 292	190, 529	129, 700	938, 182
1921	279, 560	587, 301	31, 551	77, 421	46, 751	152, 521	72, 600	817, 243
1922	368, 400	692, 693	26, 330	40, 471	68, 550	176, 852	102, 300	910, 016
1923	442, 680	782, 796	20, 630	32, 243	66, 070	167, 357	104, 760	982, 396
1924	435, 810	826, 294	25, 660	40, 505	78, 030	193, 944	116, 560	1, 060, 743
1925	478, 210	1, 012, 930	38, 810	85, 321	224, 270	304, 913	267, 450	1, 403, 164
1926	426, 950	975, 754	32, 630	80, 698	127, 330	220, 780	165, 700	1, 277, 232
1927	339, 260	724, 265	10, 740	17, 429	93, 480	151, 795	122, 710	893, 489
1928	450, 670	1, 009, 927	14, 720	23, 231	118, 130	182, 171	156, 890	1, 215, 329

SANDSTONE

The output of sandstone in 1928 amounted to 4,716,530 short tons, valued at $10,498,440, a decrease of 7 per cent in quantity and 4 per cent in value from 1927. The classes of sandstone showing increased production were flagging, rubble, riprap, and stone for "Other uses." Sandstone for building, paving blocks, curbing, crushed stone, and refractory use decreased.

Sandstone sold or used by producers in the United States, 1927 and 1928, by uses

Use	1927		1928	
	Quantity	Value	Quantity	Value
Building stone ---------- cubic feet	3, 995, 370	$3, 025, 864	2, 622, 690	$2, 643, 277
Approximate equivalent in short tons	309, 390	----------	200, 490	----------
Paving blocks ---------- number	2, 755, 770	215, 222	2, 477, 560	178, 922
Approximate equivalent in short tons	32, 510	----------	27, 990	----------
Curbing ---------- cubic feet	2, 570, 530	2, 199, 878	2, 301, 410	1, 939, 736
Approximate equivalent in short tons	188, 430	----------	169, 930	----------
Flagging ---------- cubic feet	737, 680	573. 736	832, 900	662, 750
Approximate equivalent in short tons	55, 160	----------	63, 570	----------
Crushed stone ---------- short tons	2, 832, 230	2, 910, 441	2, 616, 660	2, 845, 791
Rubble ---------- do	29, 370	43, 590	90, 650	114, 603
Riprap ---------- do	649, 410	664, 635	664, 660	850, 158
Refractory stone (ganister) ---------- do	900, 720	1, 164, 768	790, 630	1, 098, 945
Other uses ---------- do	62, 380	124, 901	91, 950	164, 258
Total (quantities approximate, in short tons)	5, 050, 600	10, 923, 035	4, 716, 530	10, 498, 440

Sandstone sold or used by producers in the United States, 1927 and 1928, by States

[Quantities approximate]

State	1927		1928	
	Short tons	Value	Short tons	Value
Alabama	37, 240	$47, 150	30, 960	$36, 675
Arizona	(1)	(1)		
Arkansas			(1)	(1)
California	877, 290	937, 450	835, 940	852, 559
Colorado	52, 470	77, 004	51, 120	69, 470
Connecticut	19, 960	41, 880	21, 920	78, 568
Georgia	(1)	(1)	(1)	(1)
Idaho	(1)	(1)	(1)	(1)
Illinois	49, 260	32, 420	83, 550	47, 961
Indiana	9, 140	12, 383		
Kansas	13, 680	27, 502	(1)	(1)
Kentucky	177, 520	248, 157	33, 990	70, 146
Massachusetts	(1)	(1)	(1)	(1)
Michigan	(1)	(1)		
Minnesota	66, 280	118, 222	17, 500	49, 396
Missouri			(1)	(1)
Montana	6, 870	13, 734	11, 240	24, 171
New Jersey	(1)	(1)	36, 460	51, 334
New Mexico	(1)	(1)	(1)	(1)
New York	[2] 99, 600	[2] 1, 104, 519	[2] 143, 240	[2] 1, 221, 775
Ohio	504, 790	3, 762, 847	415, 430	3, 226, 342
Oklahoma	(1)	(1)	(1)	(1)
Oregon	345, 200	346, 499	328, 850	413, 949
Pennsylvania	[2] 1, 484, 580	[2] 2, 439, 067	[2] 1, 462, 570	[2] 2, 437, 440
South Dakota	210, 500	275, 615	94, 380	127, 313
Tennessee	3, 530	13, 967	(1)	(1)
Texas	24, 000	36, 000	(1)	(1)
Utah	104, 030	110, 632	221, 420	347, 815
Virginia	87, 120	157, 568	118, 420	143, 220
Washington	3, 300	160, 859	10, 680	215, 192
West Virginia	62, 670	85, 947	4, 740	10, 423
Wisconsin	261, 270	434, 582	194, 180	396, 588
Wyoming			12, 450	23, 161
Undistributed	550, 300	439, 031	587, 490	654, 942
	5, 050, 600	10, 923, 035	4, 716, 530	10, 498, 440

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[1] Included under "Undistributed."

[2] Includes bluestone.

Sandstone sold or used by producers in the United States in 1928, by States and uses

State	Number of active plants	Building stone						Refractory stone (ganister)		Paving blocks		Curbing	
		Rough construction		Rough architectural		Dressed (sawed and cut)							
		Short tons	Value	Cubic feet	Value	Cubic feet	Value	Short tons	Value	Number	Value	Cubic feet	Value
Alabama	4							(1)	(1)				
Arkansas	2												
California	20	1,800	$7,640			1,400	$1,600	5,680	$12,433				
Colorado	13	(1)	(1)	(1)	(1)	(1)	(1)	22,700	34,082	(1)	(1)		
Connecticut	3	(1)	(1)	(1)	(1)	17,240	39,639			(1)	(1)		
Georgia	1							(1)	(1)				
Idaho	1					(1)	(1)						
Illinois	3							(1)	(1)				
Kansas	1												
Kentucky	4					(1)	(1)						
Massachusetts	2			(1)	(1)	(1)	(1)						
Minnesota	5					(1)	(1)						
Missouri	2	(1)	(1)										
Montana	4							(1)	(1)				
New Jersey	3	(1)	(1)	(1)	(1)								
New Mexico	1												
New York	37	3,740	14,310	168,690	$104,345	86,740	225,511			602,650	$35,717	549,910	$628,394
Ohio	17	8,910	29,749	502,400	263,487	888,230	1,191,519	8,220	18,556			1,556,250	1,144,056
Oklahoma	2	(1)	(1)										
Oregon	6												
Pennsylvania	89	28,090	73,583	34,240	29,156	21,120	88,386	558,340	721,555	1,750,310	125,841	195,250	167,286
South Dakota	6	(1)	(1)			(1)	(1)	17,760	18,902				
Tennessee	2												
Texas	1												
Utah	3					(1)	(1)						
Virginia	6			(1)	(1)	(1)	(1)						
Washington	3					44,490	200,989						
West Virginia	4	(1)	(1)										
Wisconsin	17	2,930	5,292	12,570	17,199	10,470	30,020	128,560	227,226	(1)	(1)		
Wyoming	3												
Undistributed		6,420	18,736	41,820	58,743	111,330	243,373	49,370	66,191	124,600	17,364		
	265	51,890	149,310	759,720	472,930	1,181,020	2,021,037	790,630	1,098,945	2,477,560	178,922	2,301,410	1,939,736

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[1] Included under "Undistributed."

Sandstone sold or used by producers in the United States in 1928, by States and uses—Continued

State	Flagging		Rubble		Riprap		Crushed stone				Other uses		Total	
							Concrete and road metal		Railroad ballast					
	Cubic feet	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons (approximate)	Value
Alabama			(1)	(1)									30, 960	$36, 675
Arkansas							(1)	(1)					(1)	(1)
California	4, 300	$2, 400	40, 000	$25, 000	19, 980	$31, 965	731, 150	$756, 402	5, 420	$6, 297	31, 510	$8, 822	835, 940	852, 559
Colorado	(1)	(1)	730	1, 116	(1)	(1)	19, 820	23, 667			3, 490	2, 227	51, 120	69, 470
Connecticut					(1)	(1)	(1)	(1)					21, 920	78, 568
Georgia													(1)	(1)
Idaho	(1)	(1)	(1)	(1)							(1)	(1)	(1)	(1)
Illinois							82, 560	43, 700			(1)	(1)	83. 550	47, 961
Kansas	(1)	(1)					(1)	(1)					(1)	(1)
Kentucky	(1)	(1)			(1)	(1)	(1)	(1)			(1)	(1)	33, 990	70, 146
Massachusetts							(1)	(1)					(1)	(1)
Minnesota							14, 870	29, 574			(1)	(1)	17, 500	49, 396
Missouri					(1)	(1)							(1)	(1)
Montana					(1)	(1)							11, 240	24, 171
New Jersey					(1)	(1)							36, 460	51, 334
New Mexico									(1)	(1)			(1)	(1)
New York	185, 640	118, 011	(1)	(1)	(1)	(1)	30, 230	75, 837					143, 240	1, 221, 775
Ohio	450, 630	358, 001	29, 260	38, 197	120, 550	157, 367	6, 260	14, 365			4, 400	11, 045	415, 430	3, 226, 342
Oklahoma							(1)	(1)					(1)	(1)
Oregon					(1)	(1)	(1)	(1)					328, 850	413, 949
Pennsylvania	158, 280	154, 379	9, 320	27, 377	(1)	(1)	528, 890	703, 786	268, 580	320, 410	(1)	(1)	1, 462, 570	2, 437, 440
South Dakota					(1)	(1)	75, 630	96, 285			(1)	(1)	94, 380	127, 313
Tennessee	(1)	(1)	(1)	(1)									(1)	(1)
Texas					(1)	(1)							(1)	(1)
Utah							(1)	(1)			(1)	(1)	221, 420	347, 815
Virginia							51, 360	45, 304	(1)	(1)			118, 420	143. 220
Washington	9, 150	7, 315	150	375	6, 510	6, 513							10, 680	215, 192
West Virginia							(1)	(1)					4, 740	10, 423
Wisconsin			4. 010	4, 981	5, 210	3, 313	35, 790	37, 570			(1)	(1)	194, 180	396, 588
Wyoming					(1)	(1)	(1)	(1)					12, 450	23, 161
Undistributed	24, 900	22, 644	7, 180	17, 557	512, 410	651, 000	329, 340	475, 114	436, 760	217, 480	52, 550	142, 164	587, 490	654, 942
	832, 900	662, 750	90, 650	114, 603	664, 660	850, 158	1, 905, 900	2, 301, 604	710, 760	544, 187	91, 950	164, 258	4, 716, 530	10, 498, 440

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[1] Included under "Undistributed."

BLUESTONE

The figures for bluestone are included in those for sandstone, but on account of the local importance of this stone they are also given separately. Except for a few of the large quarries, the Bureau of Mines uses the figures of sales reported by dealers, rather than those of the quarrymen, as more nearly representative of this industry.

Bluestone sold in New York and Pennsylvania, 1927 and 1928

State	Building stone		Curbing		Flagging		Other		Total	
	Cubic feet	Value	Cubic feet	Value	Cubic feet	Value	Short tons	Value	Short tons (approximate)	Value
1927										
New York	142, 980	$258, 526	353, 440	$434, 206	127, 720	$100, 844	7, 650	$5, 639	62, 330	$799, 215
Pennsylvania	10, 070	9, 362	97, 670	101, 299	83, 850	95, 980	4, 120	2, 387	20, 310	209, 028
	153, 050	267, 888	451, 110	535, 505	211, 570	196, 824	11, 770	8, 026	82, 640	1, 008, 243
1928										
New York	119, 860	226, 926	332, 560	418, 714	183, 410	116, 161	9, 130	12, 996	62, 860	774, 797
Pennsylvania	13, 210	7, 537	93, 510	94, 681	148, 640	150, 824	110	359	21, 690	253, 401
	133, 070	234, 463	426, 070	513, 395	332, 050	266, 985	9, 240	13, 355	84, 550	1, 028, 198

MISCELLANEOUS STONE

The material included under "miscellaneous" stone is mainly for concrete, road metal, and railroad ballast. Because of the nature and irregularity of production of materials in this classification the output is apt to vary greatly. In 1928 there was a decrease of 4 per cent in quantity and 14 per cent in value from 1927.

The State contributing the largest amount of miscellaneous stone is California. The output of this State includes rhyolite tuff (used as a building stone), andesite, rhyolite, trachyte, and other light-colored volcanic rocks, decomposed granite, hornblende-mica schist, and stone crushed from bowlders taken from river beds. The crushed bowlders are mostly from Los Angeles County, where part of the material taken out is sand, part screened gravel, and the rest chiefly bowlders which are crushed. The sand and screened gravel obtained are included in the report of this series on sand and gravel. Among the varieties of stone reported are argillite quarried in Arkansas, New Jersey, and Pennsylvania; phonolite from mine dumps in Colorado; cherty limestone or flint rock in Florida; rhyolite in Missouri; slate, conglomerate, and light-colored volcanic rocks in Massachusetts; and mica schist for building and refractory stone in Pennsylvania. There are also included from the other States volcanic cinders, coral rock, rhyolite, andesite, decomposed granite, mica crystal grit, serpentine, graywacke, "gyp" rock, caliche, field stone, and some stone of unknown kinds reported by local contractors or operators of portable crushers at temporary quarry sites.

Miscellaneous varieties of stone[1] *sold or used by producers in the United States, 1927 and 1928, by uses*

Use	1927		1928	
	Quantity	Value	Quantity	Value
Building stone .... cubic feet..	1,270,520	$304,597	486,400	$91,049
Approximate equivalent in short tons	107,450	....	37,830	....
Riprap and rubble .... short tons..	9,220	5,683	500,250	284,299
Crushed stone .... do....	6,933,030	6,425,940	5,960,100	5,295,820
Refractory stone (mica schist) .... do....	28,040	121,800	34,680	136,619
Other uses .... do....	37,150	113,316	291,720	191,038
Total (quantities approximate, in short tons)	7,114,890	6,971,336	6,824,580	5,998,825

[1] Includes mica schist, conglomerate, argillite, various light-colored volcanic rocks, serpentine not used as marble, and such other stone as can not be properly classed in any of the main groups.

Miscellaneous varieties of stone sold or used by producers in the United States, 1927 and 1928, by States

[Quantities approximate]

State	1927		1928	
	Short tons	Value	Short tons	Value
Arizona	....	....	271,760	$76,882
Arkansas	348,860	$368,339	305,350	335,802
California	4,682,320	4,118,582	3,801,990	2,967,232
Colorado	149,850	37,616	264,980	94,771
Florida	300,350	242,910	12,870	29,877
Idaho	(1)	(1)	(1)	(1)
Indiana	....	....	(1)	(1)
Maine	7,820	16,530	41,170	72,895
Maryland	(1)	(1)	....	....
Massachusetts	371,080	744,410	403,340	720,436
Minnesota	....	....	(1)	(1)
Missouri	(1)	(1)	(1)	(1)
Montana	(1)	(1)	(1)	(1)
Nevada	653,590	499,678	824,910	601,664
New Hampshire	(1)	(1)	(1)	(1)
New Jersey	(1)	(1)	(1)	(1)
North Carolina	141,430	142,850	32,240	73,800
Ohio	(1)	(1)	66,200	65,403
Oklahoma	....	....	20,510	16,410
Oregon	33,990	19,117	(1)	(1)
Pennsylvania	186,670	400,744	246,370	463,500
Rhode Island	75,620	159,935	(1)	(1)
South Dakota	17,190	10,188	4,340	4,050
Texas	(1)	(1)	140,870	80,841
Utah	7,810	17,243	(1)	(1)
Vermont	....	....	(1)	(1)
Virginia	45,470	45,470	....	....
Washington	4,090	3,670	23,280	14,087
West Virginia	....	....	(1)	(1)
Wisconsin	....	....	(1)	(1)
Wyoming	....	....	(1)	(1)
Undistributed	88,750	144,054	364,400	381,175
	7,114,890	6,971,336	6,824,580	5,998,825

[1] Included under "Undistributed."

Miscellaneous varieties of stone sold or used by producers in the United States in 1928, by States and uses

State	Number of active plants	Building		Riprap and rubble		Crushed stone				Other uses		Total	
						Concrete and road metal		Railroad ballast					
		Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons (approximate)	Value
Arizona	4	(1)	(1)	(1)	(1)	30, 000	$30, 000					271, 760	$76, 882
Arkansas	4			(1)	(1)	114. 660	150, 454	(1)	(1)			305, 350	335, 802
California	78	140	$10, 024	58, 580	$90, 627	3, 059, 290	2, 491, 473	400, 880	$236, 225	283, 100	$138, 883	3, 801, 990	2, 967, 232
Colorado	4			(1)	(1)	106, 900	58, 240	(1)	(1)			264, 980	94, 771
Florida	3					12, 870	29, 877					12, 870	29, 877
Idaho	2			(1)	(1)	(1)	(1)					(1)	(1)
Indiana	1							(1)	(1)			(1)	(1)
Maine	6					41, 020	72, 595			150	300	41, 170	72, 895
Massachusetts	15	990	992			402. 350	719, 444					403, 340	720, 436
Minnesota	1			(1)	(1)							(1)	(1)
Missouri	1					(1)	(1)					(1)	(1)
Montana	1			(1)	(1)			(1)	(1)			(1)	(1)
Nevada	15			(1)	(1)	530, 660	431, 001	(1)	(1)			824, 910	601, 664
New Hampshire	2					(1)	(1)			(1)	(1)	(1)	(1)
New Jersey	1	(1)	(1)			(1)	(1)					(1)	(1)
North Carolina	1					32, 240	73, 800					32, 240	73, 800
Ohio	1					66, 200	65, 403					66, 200	65, 403
Oklahoma	1			20, 510	16, 410							20, 510	16, 410
Oregon	1					(1)	(1)					(1)	(1)
Pennsylvania	22	16, 250	36, 110			190, 720	264, 577	1, 350	2, 161	38, 050	160, 652	246, 370	463, 500
Rhode Island	2	(1)	(1)			(1)	(1)					(1)	(1)
South Dakota	2					4, 340	4, 050					4, 340	4, 050
Texas	4			(1)	(1)	53, 380	28, 375	(1)	(1)			140, 870	80, 841
Utah	1									(1)	(1)	(1)	(1)
Vermont	1					(1)	(1)					(1)	(1)
Washington	4					23, 280	14, 087					23, 280	14, 087
West Virginia	1					(1)	(1)					(1)	(1)
Wisconsin	2			(1)	(1)	(1)	(1)					(1)	(1)
Wyoming	1									(1)	(1)	(1)	(1)
Undistributed		20, 450	43, 923	421, 160	177, 262	213, 600	285, 602	676, 360	338, 456	5, 100	27, 822	364, 400	381, 175
	182	37, 830	91, 049	500, 250	284, 299	4, 881, 510	4, 718, 978	1, 078, 590	576, 842	326, 400	327, 657	6, 824, 580	5, 998, 825

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[1] Included under "Undistributed."

CRUSHED STONE (CONCRETE AND ROAD METAL AND RAILROAD BALLAST)

The crushed stone sold or used by producers for concrete and road metal and for railroad ballast in the United States in 1928 amounted to 91,265,360 short tons, valued at $94,186,259. These figures represent a decrease of 4 per cent in quantity and 3 per cent in value from 1927. Crushed stone for concrete and road metal decreased 5 per cent in quantity and 4 per cent in value, and railroad ballast increased 3 per cent in quantity and decreased 1 per cent in value, compared with 1927. The total average value was $1.03 in 1928, the same as in 1927, but the average value of crushed stone for concrete and road metal ($1.09) was 2 cents more and railroad ballast ($0.78) 3 cents less than for 1927. The figures for crushed stone include reports given by various railroads relative to the noncommercial material used by them, such information as was obtainable from highway departments of the different States on the amount of noncommercial crushed stone used for road construction, and information supplied by a large number of cities, towns, and counties that crushed stone for road and repair work. This class of information is difficult to obtain on account of the irregularity of operation and the incomplete records kept by the various municipalities.

Crushed stone sold or used by producers in the United States, 1927 and 1928, by kinds and uses

Kind	Concrete and road metal		Railroad ballast		Total		
						Value	
	Short tons	Value	Short tons	Value	Short tons	Total	Average
1927							
Granite	5, 822, 810	$7, 785, 512	1, 594, 050	$1, 108, 689	7, 416, 860	$8, 894, 201	$1. 20
Basalt and related rocks (trap rock)	10, 764, 770	13, 574, 471	1, 921, 480	2, 257, 749	12, 686, 250	15, 832, 220	1. 25
Limestone	53, 750, 130	54, 638, 975	11, 330, 270	8, 772, 490	65, 080, 400	63, 411, 465	. 97
Sandstone	1, 996, 310	2, 224, 866	835, 920	685, 575	2, 832, 230	2, 910, 441	1. 03
Miscellaneous	6, 210, 190	5, 953, 413	722, 840	472, 527	6, 933, 030	6, 425, 940	. 93
	78, 544, 210	84, 177, 237	16, 404, 560	13, 297, 030	94, 948, 770	97, 474, 267	
Average value per ton		1. 07		0. 81		1. 03	
1928							
Granite	5, 407, 310	7, 057, 119	1, 532, 000	1, 317, 914	6, 939, 310	8, 375, 033	1. 21
Basalt and related rocks (trap rock)	13, 114, 050	16, 473, 278	1, 682, 740	1, 902, 190	14, 796, 790	18, 375, 468	1. 24
Limestone	49, 075, 720	50, 490, 370	11, 876, 780	8, 803, 777	60, 952, 500	59, 294, 147	. 97
Sandstone	1, 905, 900	2, 301, 604	710, 760	544, 187	2, 616, 660	2, 845, 791	1. 09
Miscellaneous	4, 881, 510	4, 718, 978	1, 078, 590	576, 842	5, 960, 100	5, 295, 820	. 89
	74, 384, 490	81, 041, 349	16, 880, 870	13, 144, 910	91, 265, 360	94, 186, 259	
Average value per ton		1. 09		0. 78		1. 03	

Crushed stone sold or used by producers in the United States, 1919–1928, by uses

Year	Concrete and road metal		Railroad ballast		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1919	26, 868, 225	$30, 553, 404	6, 805, 114	$5, 851, 782	33, 673, 339	$36, 405, 186
1920	32, 823, 900	43, 035, 030	7, 541, 960	7, 811, 663	40, 365, 860	50, 846, 693
1921	36, 765, 790	45, 338, 984	6. 437, 050	6, 378, 494	43, 202, 840	51, 717, 478
1922	42, 426, 500	47, 582, 758	7, 337, 240	6, 547, 419	49, 763, 740	54, 130, 177
1923	51, 047, 900	58, 356, 094	11, 274, 810	9, 572, 557	62, 322, 710	67, 928, 651
1924	57, 684, 210	65, 128, 692	10, 514, 230	8, 732, 884	68, 198, 440	73, 861. 576
1925	62, 823, 800	69, 986, 729	12, 849, 130	10, 521. 700	75, 672, 930	80, 508, 429
1926	66, 892, 530	75, 049, 930	15, 623, 030	12, 822, 084	82, 515, 560	87, 872, 014
1927	78, 544, 210	84, 177, 237	16, 404, 560	13, 297, 030	94, 948, 770	97, 474, 267
1928	74, 384, 490	81, 041, 349	16, 880, 870	13, 144, 910	91, 265, 360	94, 186, 259

Of the two classes of stone—dimension stone trimmed to exact or approximate dimensions for building, monumental, paving, etc., and broken stone which is not trimmed to dimension, including riprap, crushed stone, etc.—the latter group comprises about 95 per cent of the total stone production and represents 64 per cent of the total value of stone produced.

Inasmuch as 1928 was the first year to show a decline in the production of crushed stone, it is thought that some further diversification of the tabulations may be of assistance to operators in picturing conditions. With this in view, the following table has been compiled.

Crushed stone and broken stone produced in continental United States, 1927 and 1928, by regions

Region	Concrete, road metal, and railroad ballast										Other uses		
	1927				1928						1927		
	Short tons	Value f. o. b. plant		Per cent of regional total quantity	Per cent of regional total quantity	Short tons	Value f. o. b. plant		Per cent change		Short tons	Value f. o. b. plant	
		Total	Average				Total	Average	Quantity	Average value		Total	Average
Eastern States:													
Granite	1,205,370	$2,019,633	$1.68	67.5	68.4	1,152,350	$1,926,397	$1.67	−4.4	−.6	226,730	$275,404	$1.21
Basalt (trap rock)	8,818,910	11,782,520	1.34			10,104,650	13,089,757	1.30	+14.6	−0.0	74,900	336,529	4.49
Limestone	14,831,140	18,527,140	1.25			15,130,740	18,537,060	1.23	+2.0	−1.6	11,588,980	11,769,625	1.02
Sandstone	834,730	1,083,694	1.30			846,890	1,128,266	1.33	+1.5	+2.3	638,400	798,202	1.25
Miscellaneous	570,910	1,096,528	1.92			793,950	1,248,649	1.57	+39.1	−18.2	145,280	581,763	4.00
	26,261,060	34,509,515	1.31	67.5	68.4	28,028,580	35,930,129	1.28	+6.7	−2.3	12,674,290	13,761,523	1.09
Central States:													
Granite	258,910	437,146	1.69	66.6	63.5	228,150	316,363	1.39	−11.9	−17.8	10,590	14,826	1.40
Basalt (trap rock)	374,580	498,180	1.33			190,920	242,828	1.27	−49.0	−4.5	60,820	413,672	6.80
Limestone	33,760,530	30,915,351	.92			32,246,420	29,649,045	.92	−4.5		17,133,260	12,448,682	.73
Sandstone	575,410	643,835	1.12			236,360	248,294	1.05	−58.9	−6.3	384,370	500,629	1.30
Miscellaneous	42,510	65,502	1.54			133,680	166,382	1.24	+214.5	−19.5	23,130	21,908	.95
	35,011,940	32,560,014	.93	66.6	63.5	33,035,530	30,622,912	.93	−5.6		17,612,170	13,399,717	.76
Southern States:													
Granite	3,769,930	5,077,066	1.35	90.5	88.0	3,895,560	4,794,705	1.23	+3.3	−8.9	74,610	125,136	1.68
Basalt (trap rock)	138,020	133,353	.97			148,730	163,224	1.10	+7.8	+13.4			
Limestone	16,080,610	13,525,254	.84			12,895,750	10,598,446	.82	−19.8	−2.4	1,990,700	2,498,439	1.26
Sandstone	93,000	61,133	.66			169,560	139,259	.82	+82.3	+24.2	66,230	88,231	1.33
Miscellaneous	834,610	796,970	.95			385,660	407,051	1.06	−53.8	+11.6	136,530	155,809	1.14
	20,916,170	19,593,776	.94	90.5	88.0	17,495,260	16,102,685	.92	−16.4	−2.1	2,268,070	2,867,615	1.26
Western States:													
Granite	2,182,650	1,360,356	.62	79.0	81.6	1,663,250	1,337,568	.80	−23.8	+29.0	1,188,280	1,023,842	.86
Basalt (trap rock)	3,029,830	2,840,320	.94			3,943,040	4,174,257	1.06	+30.1	+12.8	203,930	298,794	1.47
Limestone	309,650	283,977	.92			613,440	417,288	.68	+98.1	−26.1	1,336,130	1,308,248	.98
Sandstone	1,329,090	1,121,779	.84			1,363,850	1,329,972	.98	+2.6	+16.7	523,510	567,242	1.08
Miscellaneous	5,485,000	4,466,940	.81			4,646,810	3,473,738	.75	−15.3	−7.4	34,910	269,114	.77
	12,336,220	10,073,372	.82	79.0	81.6	12,230,390	10,732,823	.88	−.9	+7.3	3,286,760	3,467,240	1.05
United States total	94,525,390	96,736,677	1.02	74.5	71.0	90,789,760	93,388,549	1.03	−4.0	+1.0	35,841,290	33,496,095	.93

Crushed stone and broken stone produced in continental United States, 1927 and 1928, by regions—Continued

Region	Other uses—Continued					Total									
	1928					1927				1928					
	Short tons	Value f. o. b. plant		Per cent change		Short tons	Value f. o. b. plant		Per cent of United States total quantity	Per cent of United States total quantity	Short tons	Value f. o. b. plant		Per cent change	
		Total	Average	Quantity	Average value		Total	Average				Total	Average	Quantity	Average value
Eastern States:															
Granite	239, 320	$215, 025	$0. 90	+5. 6	−25. 6	1, 432, 100	$2, 295, 037	$1. 60	30	32	1, 391, 670	$2, 141, 422	$1. 54	−2. 8	−3. 8
Basalt (trap rock)	100, 790	455, 577	4. 52	+34. 6	+. 7	8, 893, 810	12, 119, 049	1. 36			10, 205, 440	13, 545, 334	1. 33	+14. 7	−2. 2
Limestone	11, 877, 390	11, 516, 877	. 97	+2. 5	−4. 9	26, 420, 120	30, 296, 765	1. 15			27, 008, 130	30, 053, 937	1. 11	+2. 2	−3. 5
Sandstone	628, 000	803, 121	1. 28	−1. 6	+2. 4	1, 473, 130	1, 881, 896	1. 28			1, 474, 890	1, 931, 387	1. 31	+. 1	+2. 3
Miscellaneous	126, 800	498, 488	3. 93	−12. 7	−1. 8	716, 190	1, 678, 291	2. 34			920, 750	1, 747, 137	1. 90	+28. 6	−8. 8
	12, 972, 300	13, 489, 088	1. 04	+2. 4	−4. 6	38, 935. 350	48, 271, 038	1. 24	30	32	41, 000, 880	49, 419, 217	1. 21	+5. 3	−2. 4
Central States:															
Granite	73, 020	53, 636	. 73	+589. 5	−47. 9	269, 500	451, 972	1. 68	40	40	301, 170	369, 999	1. 23	+11. 8	−26. 8
Basalt (trap rock)	42, 800	298, 500	6. 97	−29. 6	+2. 5	435, 400	911, 852	2. 09			233, 720	541, 328	2. 32	−46. 3	+11. 0
Limestone	18, 429, 740	13, 396, 872	. 73	+7. 6	--------	50, 893, 790	43, 364, 033	. 85			50, 676, 160	43, 045, 917	. 85	−. 4	--------
Sandstone	376, 060	612, 820	1. 63	−2. 2	+25. 4	959, 780	1, 144, 464	1. 19			612, 420	861, 114	1. 41	−36. 2	+18. 5
Miscellaneous	7, 480	10, 496	1. 40	−67. 7	+47. 4	65, 640	87, 410	1. 33			141, 160	176, 878	1. 25	+115. 1	−6. 0
	18, 929, 100	14, 372, 324	. 76	+7. 5	--------	52, 624, 110	45, 959, 731	. 87	40	40	51, 964, 630	44, 995, 236	. 87	−1. 3	--------
Southern States:															
Granite	150, 060	166, 666	1. 11	+101. 1	−33. 9	3, 844, 540	5, 202, 202	1. 35	18	16	4, 045, 620	4, 961, 371	1. 23	+5. 2	−8. 9
Basalt (trap rock)	2, 180	4, 810	2. 21	--------	--------	138, 020	133, 353	. 97			150, 910	168, 034	1. 11	+9. 3	+14. 4
Limestone	1, 937, 600	2, 369, 396	1. 22	−2. 7	−3. 2	18, 071, 310	16, 023, 693	. 89			14, 833, 350	12, 967, 842	. 87	−17. 9	−2. 2
Sandstone	110, 320	151, 740	1. 38	+66. 6	+3. 8	159, 230	149, 364	. 94			279, 880	290, 999	1. 04	+75. 8	+10. 6
Miscellaneous	220, 600	221, 582	1. 00	+61. 6	−12. 3	971, 140	952, 779	. 98			606, 260	628, 633	1. 04	−37. 6	+6. 1
	2, 420, 760	2. 914, 194	1. 20	+6. 7	−4. 8	23, 184, 240	22, 461, 391	. 97	18	16	19, 916, 020	19, 016, 879	. 95	−14. 1	−2. 1
Western States:															
Granite	515, 820	432, 727	. 84	−56. 6	−2. 3	3, 370, 930	2, 384, 198	. 71	12	12	2, 179, 070	1, 770, 295	. 81	−35. 4	+14. 1
Basalt (trap rock)	159, 160	232, 266	1. 46	−22. 0	−. 7	3, 233, 760	3, 139, 114	. 97			4, 102, 200	4, 406, 523	1. 07	+26. 9	+10. 3
Limestone	999, 240	1, 130, 159	1. 13	−25. 2	+15. 3	1, 645, 780	1, 592, 225	. 97			1, 612, 680	1, 547, 447	. 96	−2. 0	−1. 0
Sandstone	432, 860	545, 678	1. 26	−17. 3	+16. 7	1, 852, 600	1, 689, 021	. 91			1, 796, 710	1, 875, 650	1. 04	−3. 0	+14. 3
Miscellaneous	632, 460	358, 235	. 57	+1, 711. 7	−26. 0	5, 519, 910	4, 736, 054	. 86			5, 279, 270	3, 831, 973	. 73	−4. 4	−15. 1
	2. 739, 540	2, 699, 065	. 99	−16. 6	−5. 7	15, 622, 980	13, 540, 612	. 87	12	12	14, 969, 930	13, 431, 888	. 90	−4. 2	+3. 4
United States total	37, 061, 700	33, 474, 671	. 90	+3. 4	−3. 2	130, 366, 680	130, 232, 772	1. 00	100	100	127, 851, 460	126, 863, 220	. 99	−1. 9	−1. 0

Production of broken stone has been subdivided into four groups of States, as follows:

Eastern:
  West Virginia, Pennsylvania, New York, Maryland, Rhode Island, Delaware, New Jersey, Connecticut, Massachusetts, New Hampshire, Vermont, Maine, and District of Columbia.
Central:
  North Dakota, South Dakota, Nebraska, Kansas, Minnesota, Iowa, Missouri, Wisconsin, Illinois, Michigan, Indiana, Ohio, and Kentucky.
Southern:
  Texas, Oklahoma, Arkansas, Louisiana, Tennessee, Mississippi, Alabama, Georgia, Florida, North Carolina, South Carolina, and Virginia.
Western:
  California, Washington, Oregon, Nevada, Idaho, Montana, Wyoming, Utah, Colorado, Arizona, and New Mexico.

Stone used for concrete, road metal, and railway ballast has been combined, and under "Other uses" are included agricultural and fluxing limestone, riprap, etc. No stone used for lime or cement is included in this table. The figures in this table also relate only to continental United States.

One column shows the average selling price f. o. b. plant, and others show the percentage of increase or decrease for 1928 over 1927 production and the average value per ton. Columns 4 and 5 show the percentage of the total production from each group of States sold for concrete, road metal, and ballast. Columns 22 and 23 show the percentage of the United States production supplied by each group of States.

The table is not discussed in detail because each interested reader will desire comparisons and computations from differing angles of approach. It is to be noted, however, that the table shows that the increase or decrease of production does not at all times parallel increase or decrease in sales value and that changes in the proportions of the various stones used differ with varying exigencies and demand in the different regions. For example, total limestone production decreased in the Central, Southern, and Western States and increased in the Eastern States, whereas total basalt production increased in the Eastern, Southern, and Western States and decreased in the Central States.

Attention is also called to the increase in the use of various stones for "Other uses." It would be interesting to present such uses in greater detail but to do so would involve disclosure of individual producers' figures.

The following table is presented to indicate the percentage in which the various kinds of stone enter certain uses or markets in the four sections of the country. For example, in 1928 only six-tenths of 1 per cent of the stone used for concrete, road metal, and railroad ballast was basalt in the Central States, whereas 36.1 per cent of the material used for these purposes was basalt in the Eastern States.

Per cent of crushed stone and broken stone produced for various uses, 1927 and 1928, by kinds of stone

Use and kind	Eastern States		Central States		Southern States		Western States	
	1927	1928	1927	1928	1927	1928	1927	1928
Concrete, road metal, and railroad ballast:								
Granite	4. 6	4. 1	0. 7	0. 7	18. 0	22. 3	17. 7	13. 6
Basalt (trap rock)	33. 6	36. 1	1. 1	. 6	. 7	. 8	24. 5	32. 2
Limestone	56. 5	54. 0	96. 4	97. 6	76. 9	73. 7	2. 5	5. 0
Sandstone	3. 2	3. 0	1. 7	. 7	. 4	1. 0	10. 8	11. 2
Miscellaneous	2. 1	2. 8	. 1	. 4	4. 0	2. 2	44. 5	38. 0
Other uses:								
Granite	1. 8	1. 8	. 1	. 4	3. 3	6. 2	36. 2	18. 8
Basalt (trap rock)	. 6	. 8	. 3	. 2	--------	. 1	6. 2	5. 8
Limestone	91. 4	91. 6	97. 3	97. 4	87. 8	80. 0	40. 6	36. 5
Sandstone	5. 0	4. 8	2. 2	2. 0	2. 9	4. 6	15. 9	15. 8
Miscellaneous	1. 2	1. 0	. 1	--------	6. 0	9. 1	1. 1	23. 1

CEMENT[1]

By B. W. Bagley

GENERAL REVIEW

The final figures of production and shipments of Portland cement in 1928, compiled from the annual reports of the producers, confirm the estimates summarized from the monthly reports of the producers and published by the Bureau of Mines early in January, 1929. The production of Portland cement in 1928—176,298,846 barrels—was the greatest quantity manufactured in any year, exceeding that in 1927, the next highest year in production, by 2 per cent.

In 1928 there were shipped from the mills 175,838,332 barrels of Portland cement, valued at $275,972,945, an increase of 2 per cent in quantity and a decrease of 1 per cent in gross value. The average factory value per barrel in bulk in 1928 was $1.57, a decrease of 5 cents per barrel as compared with 1927.

The stocks of finished Portland cement at the mills at the end of 1928—22,917,896 barrels—were the greatest at the end of any year during which official records of stocks have been kept and were about 2 per cent higher than on December 31, 1927. At the end of December, 1928, there were also on hand at the mills, according to estimates by the manufacturers, 7,422,000 barrels of clinker, or unground cement, as compared with 7,660,000 barrels at the end of 1927, a decrease of 3 per cent.

Production showed an increase each month over 1927 except in March and April, when slight decreases were recorded. Monthly shipments also showed increases over the preceding year except in February, March, April, and June. Both production and shipments, as in 1927, were at their height in August.

At the end of October, when stocks of both finished cement and clinker, unground cement, were lowest, about 14,579,000 barrels of finished cement and 5,944,000 barrels of clinker were in stock at the mills. The monthly average for the finished cement stocks for the year was more than 22,714,000 barrels and for the clinker stocks 10,550,000 barrels, as compared with 19,986,000 barrels and 9,640,000 barrels, respectively, for 1927.

Production and shipments of masonry, natural, and puzzolan cements also increased in 1928, production exceeding that of 1927 by 4 per cent; shipments showed an increase over 1927 of nearly 3 per cent.

The following table summarizes the value of buildings shown by permits issued during 1925 to 1928 in 210 cities, representing all parts of the United States, and shows the general trend of building construction during these years. The grand total showed a decrease each year from 1925 to 1928. All the districts except four shared in the total decrease of 3 per cent in 1928 from 1927.

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[1] Work on manuscript completed December, 1929.

Value of buildings shown by permits issued in 210 cities in the United States, 1925–1928 [1]

Group of cities	1925	1926	1927	1928	Increase or decrease, 1928 from 1927 (per cent)
New England	$251, 184, 000	$198, 844, 000	$189, 912, 000	$177, 570, 000	−6
New York and northern New Jersey	1, 278, 820, 000	1, 317, 532, 000	1, 168, 291, 000	1, 162, 451, 000	−. 5
Eastern Pennsylvania, southern New Jersey, Maryland, Delaware, District of Columbia, and Virginia	386, 637, 000	316, 990, 000	259, 855, 000	275, 717, 000	+6
Western Pennsylvania, West Virginia, Ohio, and Kentucky	309, 712, 000	273, 862, 000	253, 651, 000	254, 953, 000	+1
Illinois, Indiana, Iowa, Wisconsin, Michigan, Missouri, Kansas, Nebraska, and Oklahoma	906, 186, 000	894, 393, 000	828, 351, 000	759, 088, 000	−8
Minnesota, North Dakota, and South Dakota	65, 548, 000	48, 762, 000	40, 726, 000	39, 134, 000	−4
North Carolina, South Carolina, Georgia, Florida, Alabama, Mississippi, Tennessee, Arkansas, and Louisiana	234, 617, 000	228, 085, 000	156, 252, 000	156, 878, 000	+. 4
Arizona, New Mexico, and Texas	98, 083, 000	94, 769, 000	85, 300, 000	84, 826, 000	−. 6
Colorado, Utah, Montana, Idaho, and Wyoming	39, 623, 000	25, 682, 000	28, 629, 000	28, 983, 000	+1
California, Washington, and Oregon	417, 065, 000	359, 802, 000	329, 104, 000	286, 748, 000	−13
	3, 987, 475, 000	3, 758, 721, 000	3, 340, 071, 000	3, 226, 348, 000	−3

[1] From Bulletin of Portland Cement Association, showing values tabulated in detail by cities, based on Bradstreet's and F. W. Dodge Corporation building statistics.

The following table summarizes the value of contracts awarded in Eastern and Central States for buildings of all classes and for engineering construction of all other kinds, including public works:

Value of contracts awarded for building and all other construction work in Eastern and Central States, 1925–1928 [1]

Group of States	1925	1926	1927	1928	Increase or decrease, 1928 from 1927 (per cent)
New England	$477, 181, 000	$441, 183, 000	$412, 767, 000	$495, 581, 000	+20
New York and northern New Jersey	1, 601, 257, 000	1, 775, 060, 000	1, 684, 445, 000	1, 814, 317, 000	+8
Eastern Pennsylvania, southern New Jersey, Maryland, Delaware, District of Columbia, and Virginia	552, 318, 000	689, 414, 000	721, 148, 000	787, 673, 000	+9
Western Pennsylvania, West Virginia, Ohio, and Kentucky	828, 642, 000	741, 368, 000	758, 135, 000	723, 416, 000	−5
Illinois, Indiana, Iowa, Wisconsin, Michigan, Missouri, Kansas, Nebraska, and Oklahoma	1, 487, 310, 000	1, 669, 043, 000	1, 812, 849, 000	1, 934, 775, 000	+7
Minnesota, North and South Dakota, and northern Michigan	95, 229, 000	102, 118, 000	83, 817, 000	80, 191, 000	−4
North and South Carolina, Georgia, Florida, Alabama, Mississippi, Tennessee, Arkansas, and Louisiana	779, 132, 000	730, 317, 000	610, 789, 000	560, 925, 000	−8
Texas	185, 358, 000	232, 412, 000	219, 105, 000	231, 409, 000	+6
	6, 006, 427, 000	6, 380, 915, 000	6, 303, 055, 000	6, 628, 287, 000	+5

[1] From Bulletin of Portland Cement Association, based on compilations by F. W. Dodge Corporation.

CHIEF HYDRAULIC CEMENTS

The accompanying table gives statistics of output of Portland and other (masonry, natural, and puzzolan) hydraulic cements from 1919 to 1928. The quantity of these cements produced in the United States in 1928 increased 2 per cent as compared with 1927; the shipments from the mills in 1928 also increased 2 per cent in quantity, but they decreased 1 per cent in value.

Statistics of output of alumina cement, representing the operations of only one manufacturer in the United States, are not included in this or other tables of this report. No production of this type of cement was reported for 1923, but it was marketed from 1924 to 1928. The indications are that its use will steadily increase.

Principal hydraulic cements produced and shipped in the United States, 1919–1928

Year	Number of active plants	Production				
		Portland cement, barrels	Masonry, natural, and puzzolan cements		Total	
			Number of active plants	Barrels	Number of active plants	Barrels
1919	111	80, 777, 935	8	(1)	119	(1)
1920	117	100, 023, 245	9	(1)	126	(1)
1921	115	98, 842, 049	9	(1)	124	(1)
1922	118	114, 789, 984	9	(1)	127	(1)
1923	126	137, 460, 238	10	(1)	136	(1)
1924	132	149, 358, 109	10	(1)	142	(1)
1925	138	161, 658, 901	10	1. 729, 343	148	163, 388, 244
1926	140	164, 530, 170	11	2, 104, 891	151	166, 635, 061
1927	153	173, 206, 513	11	2, 123, 868	164	175, 330, 381
1928	156	176, 298, 846	11	2, 210, 404	167	178, 509, 250

Year	Shipments					
	Portland cement		Masonry, natural, and puzzolan cements		Total	
	Barrels	Value	Barrels	Value	Barrels	Value
1919	85, 612, 899	$146, 734, 844	528, 589	$583, 554	86, 141, 488	$147, 318, 398
1920	96, 311, 719	194, 439, 025	767, 481	1, 150, 890	97, 079, 200	195, 589, 915
1921	95, 507, 147	180, 778, 415	539, 402	897, 025	96, 046, 549	181, 675, 440
1922	117, 701, 216	207, 170, 430	889, 428	1, 293, 598	118, 590, 644	208, 464, 028
1923	135, 912, 118	257, 684, 424	1, 271, 674	1, 947, 352	137, 183, 792	259, 631, 776
1924	146, 047, 549	264, 046, 708	1, 418, 461	2, 006, 559	147, 466, 010	266, 053, 267
1925	157, 295, 212	278, 524, 108	1, 751. 725	2, 551, 583	159, 046, 937	281, 075, 691
1926	162, 187, 090	277, 965, 473	2, 031, 851	2, 820, 110	164, 218, 941	280, 785, 583
1927	171, 864, 728	278, 854, 647	2, 158, 323	2, 881, 029	174, 023, 051	281, 735, 676
1928	175, 838, 332	275, 972, 945	2, 213, 645	2, 910, 097	178, 051, 977	278, 883, 042

[1] Figures for production of masonry, natural, and puzzolan cements not available.

HYDRAULIC CEMENT PLANTS

Many requests for general information concerning the location of the plants manufacturing hydraulic cement have been received by the Bureau of Mines. To supply this information the following list has been prepared (as of October 31, 1929); the arrangement is alphabetical by States and location of plants, with the trade name of the cement as reported by the producer:

PORTLAND CEMENT

	Trade name
Alabama:	
Leeds—Atlas Portland Cement Co., New York, N. Y.	Atlas.
North Birmingham—	
Lehigh Portland Cement Co., Allentown, Pa.	Lehigh.
Lone Star Cement Co. Alabama, Birmingham.	Lone Star.
Phoenixville—Alpha Portland Cement Co., Birmingham	Alpha.
Ragland—National Cement Co., Birmingham	Coosa.
Spocari—Lone Star Cement Co. Alabama, Birmingham	Lone Star.
Arkansas:	
Foreman—American Portland Cement Co., Foreman. (Under construction Oct. 31, 1929.)	
Okay—Arkansas Portland Cement Co., Denver, Colo. (Not completed or productive until 1929.)	OK.
California:	
Cement—Pacific Portland Cement Co., San Francisco	Golden Gate.
Chubbock—National Portland Cement Co., Houston, Tex. (Under construction Oct. 31, 1929.)	
Colton—California Portland Cement Co., Los Angeles	Colton.
Cowell—Cowell Portland Cement Co., Cowell	Mt. Diablo.
Crestmore—Riverside Cement Co., Los Angeles.	Riverside.
Davenport—Santa Cruz Portland Cement Co., San Francisco	Santa Cruz.
Merced—Yosemite Portland Cement Corporation, San Francisco	Yosemite.
Monolith—Monolith Portland Cement Co., Los Angeles	Monolith.
Oro Grande—Riverside Cement Co., Los Angeles.	Bear and Plastite.
Redwood City—Pacific Portland Cement Co., San Francisco	Golden Gate.
San Andreas—Calaveras Cement Co., San Francisco	Big Tree and Calaveras.
San Juan Bautista—Pacific Portland Cement Co., San Francisco	Old Mission.
Victorville—Southwestern Portland Cement Co., Los Angeles	Victor.
Colorado:	
Boettcher—Colorado Portland Cement Co., Denver	Ideal.
Concrete—United States Portland Cement Co., Denver	Concrete.
Portland—Colorado Portland Cement Co., Denver.	Ideal.
Florida: Hookers Point (near Tampa)—Florida Portland Cement Co., Tampa	Florida.
Georgia:	
Clinchfield—Pennsylvania-Dixie Cement Corporation, Chattanooga, Tenn	Clinchfield.
Portland—Georgia Cement & Products Co., Birmingham, Ala	Piedmont.
Rockmart—Southern States Portland Cement Co., Rockmart	Southern States.
Idaho: Idaho Portland Cement Co., Inkom. (Not completed or productive until 1929.)	Eagle.
Illinois:	
Dixon—Medusa Portland Cement Co., Cleveland, Ohio	Medusa.
La Salle—	
Alpha Portland Cement Co., Easton, Pa	Alpha.
Marquette Cement Manufacturing Co., Chicago	Marquette and Super.

Illinois—Continued.	Trade name
Oglesby—Lehigh Portland Cement Co., Allentown, Pa	Lehigh.
Indiana:	
Buffington—Universal Portland Cement Co., Chicago, Ill	Universal.
Limedale—Lone Star Cement Co. Indiana (Inc.), Indianapolis	Incor and Lone Star.
Mitchell—Lehigh Portland Cement Co., Allentown, Pa	Lehigh.
Speed—Louisville Cement Co., Louisville, Ky. (Also masonry and natural cements.)	Speed.
Stroh—Wabash Portland Cement Co., Detroit, Mich	Wabash.
Iowa:	
Davenport—Dewey Portland Cement Co., Kansas City, Mo	Dewey.
Des Moines—Hawkeye Portland Cement Co., Des Moines	Hawkeye.
Gilmore City—Northwestern States Portland Cement Co., Mason City	Northwestern.
Mason City—	
Lehigh Portland Cement Co., Allentown, Pa	Lehigh.
Northwestern States Portland Cement Co., Mason City	Northwestern.
Valley Junction—Pennsylvania-Dixie Cement Corporation, Des Moines	Pyramid.
Kansas:	
Bonner Springs—Lone Star Cement Co. (Kansas), Kansas City, Mo	Lone Star.
Chanute—Ash Grove Lime & Portland Cement Co., Kansas City, Mo	Ash Grove.
Fredonia—Consolidated Cement Corporation, Kansas City, Mo	Fredonia.
Humboldt—Monarch Cement Co., Humboldt	Monarch.
Independence—Atlas Portland Cement Co. (of Kansas), New York, N. Y	Atlas.
Iola—Lehigh Portland Cement Co., Allentown, Pa	Lehigh.
Mildred—Consolidated Cement Corporation, Kansas City, Mo	Victor.
Kentucky: Kosmosdale—Kosmos Portland Cement Co. (Inc.), Louisville. (Also masonry and natural cements)	Kosmos.
Louisiana: New Orleans—Lone Star Cement Co. Louisiana, New Orleans	Lone Star.
Maine: Thomaston—Lawrence Portland Cement Co., New York, N. Y	Dragon.
Maryland:	
Security—North American Cement Corporation, Hagerstown	Security.
Union Bridge—Lehigh Portland Cement Co., Allentown, Pa	Lehigh.
Michigan:	
Alpena—Huron Portland Cement Co., Detroit	Huron.
Bay City—Aetna Portland Cement Co., Detroit	Aetna.
Bellevue—Alpha Portland Cement Co., Easton, Pa	Alpha.
Cement City—Consolidated Cement Corporation, Cement City	Peninsular.
Chelsea—Michigan State Cement Industry, Chelsea	Michigan State.
Coldwater—Wolverine Portland Cement Co., Coldwater	Wolverine.
Dearborn—Ford Motor Co., Dearborn	Ford.
Detroit—Peerless-Egyptian Cement Co., Detroit	Peerless and Super.
Fenton—Aetna Portland Cement Co., Detroit	Aetna.

	Trade name
Michigan—Continued.	
Newaygo—Newaygo Portland Cement Co., Newaygo	Newaygo.
Petoskey—Petoskey Portland Cement Co., Petoskey	Petoskey.
Port Huron—Peerless-Egyptian Cement Co., Detroit	Peerless and Super.
Quincy—Wolverine Portland Cement Co., Coldwater	Wolverine.
Union City—Peerless-Egyptian Cement Co., Detroit	Peerless and Super.
Wyandotte—Huron Portland Cement Co., Detroit	Wyandotte.
Minnesota: Duluth—Universal Portland Cement Co., Chicago, Ill	Universal.
Missouri:	
Cape Girardeau—Marquette Cement Manufacturing Co., Chicago, Ill	Marquette and Super.
Hannibal—Atlas Portland Cement Co., New York, N. Y	Atlas.
Prospect Hill—Missouri Portland Cement Co., St. Louis	Prestolith Velo and Red Ring.
St. Louis—Alpha Portland Cement Co., Easton, Pa	Alpha.
Sugar Creek—Missouri Portland Cement Co., St. Louis	Red Ring.
Montana:	
Hanover—Three Forks Portland Cement Co., Denver, Colo	Red Devil.
Trident—Three Forks Portland Cement Co., Denver, Colo	Do.
Nebraska:	
Louisville—Ash Grove Lime & Portland Cement Co., Louisville. (Not completed or productive until 1929.)	Ash Grove.
Superior—Nebraska Cement Co., Denver, Colo	Ideal and Superior.
New Jersey:	
Stewartsville—Edison Portland Cement Co., Orange	Edison.
Vulcanite—Vulcanite Portland Cement Co., Philadelphia, Pa	Super and Vulcanite.
New York:	
Alsen—	
Lehigh Portland Cement Co., Allentown Pa	Lehigh.
North American Cement Corporation, Albany	Acme.
Buffalo—	
Federal Portland Cement Co., Youngstown, Ohio	Bessemer and Super.
Great Lakes Portland Cement Corporation, Buffalo	Lehigh.
Cementon—Alpha Portland Cement Co., Easton, Pa	Alpha.
Glens Falls—Glens Falls Portland Cement Co., Glens Falls	Iron Clad and Iron Clad Velo.
Howes Cave—North American Cement Corporation, Albany	Helderberg.
Hudson—	
Lone Star Cement Co. New York (Inc.), Albany	Lone Star.
New York & New England Cement & Lime Co. (Atlas Portland Cement Co.), New York	Atlas.
Jamesville—Alpha Portland Cement Co., Easton, Pa	Alpha.
Portland Point—Pennsylvania-Dixie Cement Corporation, Nazareth, Pa	Pennsylvania.

	Trade name
Ohio:	
Baybridge—Medusa Portland Cement Co., Cleveland	Medusa.
Castalia—Castalia Portland Cement Co., Pittsburgh, Pa	Castalia.
Fairport—Standard Portland Cement Co., Painesville	Standard.
Fultonham—Pittsburgh Plate Glass Co., Zanesville	Columbia.
Ironton—Alpha Portland Cement Co., Easton, Pa	Alpha.
Middle Branch—Diamond Portland Cement Co., Middle Branch	Diamond.
Osborn—	
Southwestern Portland Cement Co., Osborn	Miami.
Wabash Portland Cement Co., Detroit, Mich	Wabash.
Silica—Medusa Portland Cement Co., Cleveland	Medusa.
Superior—Wellston Iron Furnace Co., Jackson	Superior.
Oklahoma:	
Ada—Oklahoma Portland Cement Co., Denver, Colo	OK.
Dewey—Dewey Portland Cement Co., Kansas City, Mo	Dewey.
Oregon:	
Gold Hill—Beaver Portland Cement Co., Portland	Beaver.
Lime—Oregon Portland Cement Co., Portland	Sun.
Oswego—Oregon Portland Cement Co., Portland	Oregon.
Pennsylvania:	
Bath—	
Keystone Portland Cement Co., Philadelphia	Keystone.
Lehigh Portland Cement Co., Allentown	Lehigh.
Pennsylvania-Dixie Cement Corporation, Nazareth	Pennsylvania.
Bessemer—Bessemer Limestone & Cement Co., Youngstown, Ohio	Bessemer and Super.
Cementon—Whitehall Cement Manufacturing Co., Philadelphia	Whitehall.
Conshohocken—Valley Forge Cement Co., Catasauqua	Valley Forge.
Coplay—	
Atlas Portland Cement Co., New York, N. Y	Atlas.
Coplay Cement Manufacturing Co., Coplay	Saylors.
Egypt—Giant Portland Cement Co., Philadelphia	Giant.
Evansville—Allentown Portland Cement Co., Catasauqua	Allentown.
Fogelsville—Lehigh Portland Cement Co., Allentown	Lehigh.
Martins Creek—Alpha Portland Cement Co., Easton	Alpha.
Nazareth—	
Lone Star Cement Co. Pennsylvania, Philadelphia	Lone Star.
Nazareth Cement Co., Nazareth	Nazareth.
Pennsylvania-Dixie Cement Corporation, Nazareth	Dexter.
New Castle—Lehigh Portland Cement Co., Allentown	Lehigh.
Northampton—Atlas Portland Cement Co., New York, N. Y	Atlas and Atlas White.
Ormrod—Lehigh Portland Cement Co., Allentown	Lehigh.
Penn-Allen—Pennsylvania-Dixie Cement Corporation, Nazareth	Penn-Allen.
Pittsburgh—Davison Coke & Iron Co., Pittsburgh. (Not completed or productive until 1929.)	Green Bag.
Sandts Eddy—Lehigh Portland Cement Co., Allentown	Lehigh.

	Trade name
Pennsylvania—Continued.	
Siegfried—Lawrence Portland Cement Co., New York, N. Y. (Also masonry and natural cements.)	Dragon and Super.
Stockertown—Hercules Cement Corporation, Philadelphia	Hercules.
Universal—Universal Portland Cement Co., Chicago, Ill	Universal.
Wampum—Crescent Portland Cement Co., Cleveland, Ohio	Crescent.
West Coplay—Lehigh Portland Cement Co., Allentown	Lehigh.
West Winfield—West Penn Cement Co., Butler	West Penn.
York—Medusa Portland Cement Co., Cleveland, Ohio	Medusa.
South Dakota: Rapid City—South Dakota Cement Plant, Rapid City	Dacotah.
Tennessee:	
Caswell—Volunteer Portland Cement Co., Knoxville	Volunteer.
Chattanooga—Signal Mountain Portland Cement Co., Chattanooga	Signal Mountain.
Cowan—Cumberland Portland Cement Co., Cowan	Cumberland.
Kingsport—Pennsylvania-Dixie Cement Corporation, Chattanooga	Clinchfield.
Nashville—Hermitage Portland Cement Co., Nashville	Hermitage (Old Hickory)
Richard City—Pennsylvania-Dixie Cement Corporation, Chattanooga	Royal.
Texas:	
Cement—Lone Star Cement Co. Texas, Dallas	Lone Star.
Cementville—San Antonio Portland Cement Co., San Antonio	Alamo.
Eagle Ford—Trinity Portland Cement Co., Dallas	Trinity.
El Paso—Southwestern Portland Cement Co., El Paso	El Toro.
Fort Worth—Trinity Portland Cement Co., Dallas	Trinity.
Houston—	
National Portland Cement Co., Houston. (Under construction Oct. 31, 1929.)	----------
Trinity Portland Cement Co., Dallas	Trinity.
Longhorn—Republic Portland Cement Co., San Antonio. (Not completed or productive until 1929.)	Longhorn.
Manchester—Lone Star Cement Co. Texas, Dallas	Lone Star.
Waco—Atlas Portland Cement Co., Waco. (Not completed or productive until 1929.)	Atlas.
Utah:	
Bakers—Utah-Idaho Cement Co., Brigham	Beehive.
Devils Slide—Union Portland Cement Co., Denver, Colo	Red Devil.
Salt Lake City—Portland Cement Co. of Utah, Salt Lake City	Utah.
Virginia:	
Fordwick—Lehigh Portland Cement Co., Allentown, Pa	Lehigh.
Norfolk—Lone Star Cement Co. Virginia (Inc.), Norfolk	Lone Star.
Washington:	
Bellingham—Olympic Portland Cement Co. (Ltd.), Seattle	Olympic.
Concrete—Superior Portland Cement (Inc.), Seattle	Superior.

	Trade name
Washington—Continued.	
Grotto—Northwestern Portland Cement Co., Grotto	Northwest.
Irvin—International Portland Cement Co. (Ltd.), Spokane	Spokane.
Metaline Falls—Lehigh Portland Cement Co., Allentown, Pa	Lehigh.
Seattle—Pacific Coast Cement Co., Seattle. (Not completed or productive until 1929.)	Diamond and Double Diamond.
West Virginia:	
Kenova—Basic Products Co., Kenova	Green Bag.
Manheim—Alpha Portland Cement Co., Easton, Pa	Alpha.
Martinsburg—Standard Lime & Stone Co., Baltimore, Md	Capitol.
Wisconsin: Manitowoc—Manitowoc Portland Cement Co., Manitowoc	Badger State.
Wyoming: Laramie—Monolith-Portland Midwest Co., Los Angeles, Calif. (Not completed or productive until 1929.)	Monolith.

MASONRY AND NATURAL CEMENTS

Illinois: Utica—Utica Hydraulic Cement Co., Utica	Utica.
Indiana: Speed—Louisville Cement Co., Louisville, Ky. (Also Portland cement.)	Brixment and Star.
Kansas: Fort Scott—Fort Scott Hydraulic Cement Co., Fort Scott	Fort Scott Hydraulic.
Kentucky: Kosmosdale—Kosmos Portland Cement Co. (Inc.), Louisville. (Also Portland cement.)	Kosmortar.
Minnesota:	
Austin—Austin Cement Works, Mankato	Austin Bricklayer.
Carney—Carney Co., Mankato	Carney.
Mankato—Carney Co., Mankato	Do.
New York:	
Brixment—Louisville Cement Co., Louisville, Ky	Brixment.
Rosendale—	
Century Cement Corporation, Rosendale. (Not completed or productive until 1929.)	Century.
A. J. Snyder & Co., Rosendale	Crescent.
Ohio: Lisbon (near)—Lisbon Cement Co., Lisbon	Hydraulic.
Pennsylvania: Siegfried—Lawrence Portland Cement Co., New York, N. Y. (Also Portland cement.)	Hy-Test Mason's.

PUZZOLAN CEMENT

Alabama: North Birmingham—Southern Cement Co., Birmingham	Magnolia.

ALUMINA CEMENT

Missouri: Hannibal—Atlas Lumnite Cement Co., New York, N. Y	Atlas Lumnite.
Pennsylvania: Northampton—Atlas Lumnite Cement Co., New York, N. Y	Do.

PORTLAND CEMENT

PRODUCTION, SHIPMENTS, AND STOCKS

Including Maine, whose new plant began manufacturing Portland cement in April, 1928, and shipping in May, there were 32 producing States in 1928 as compared with 31 in 1927. Of the 31 States in which Portland cement was manufactured in both 1927 and 1928, 19 showed increases in production and 18 showed increases in shipments in 1928, as compared with 1927. All the commercial districts, except eastern Pennsylvania-New Jersey-Maryland, Michigan, Virginia-Tennessee-Alabama-Georgia-Florida-Louisiana, and California, showed increased production, and all except the first and last named showed increased shipments; the gains in production ranged from 3 to 27 per cent and in shipments from 1 to 15 per cent. The net change for the country as a whole was an increase of 2 per cent in both production and shipments. The production of 176,298,846 barrels of 376 pounds net is equivalent to 705,195,384 sacks, 29,593,021 long tons, or 33,144,183 short tons. In 1928 production exceeded shipments by 460,514 barrels.

In the following table the statistics are arranged by States, so far as permissible, and by districts. The term "active plant" is applied to a mill or group of mills situated at one place and operated by one company. If a company has establishments at different places, its mill or group of mills at each place is counted as a plant. The districts are groups of States geographically and commercially related.

Portland cement produced, shipped, and in stock in the United States, 1927–28, by States and districts

	Active plants		Production			Shipments							Stock (Dec. 31)		
			Barrels		Increase or decrease, 1928 (per cent)	1927		1928		Average factory value per barrel		Increase or decrease in quantity, 1928 (per cent)	Barrels		Increase or decrease, 1928 (per cent)
	1927	1928	1927	1928		Barrels	Value	Barrels	Value	1927	1928		1927 (revised)	1928	
STATE															
Alabama	6	6	7, 564, 863	6, 749, 202	−11	7, 313, 494	$10, 615, 428	6, 696, 684	$8, 233, 872	$1. 45	$1. 23	−8	655, 024	707, 542	+8
California	12	12	14, 580, 654	13, 555, 579	−7	14, 433, 153	26, 623, 396	13, 699, 851	25, 906, 942	1. 84	1. 89	−5	840, 506	696, 234	−17
Illinois	4	4	7, 017, 047	7, 334, 833	+5	7, 061, 240	11, 312, 783	7, 405, 667	11, 602, 848	1. 60	1. 57	+5	768, 275	697, 441	−9
Iowa	5	6	5, 415, 144	7, 070, 172	+31	5, 661, 234	9, 124, 405	6, 880, 731	10, 734, 838	1. 61	1. 56	+22	1, 370, 481	1, 559, 922	+14
Kansas	7	7	6, 180, 255	6, 574, 219	+6	6, 141, 937	9, 939, 412	6, 787, 568	10, 091, 330	1. 62	1. 49	+11	1, 137, 286	923, 937	−19
Michigan	15	14	13, 965, 241	13, 848, 561	−1	13, 708, 259	20. 858, 202	14, 044, 230	19, 268, 707	1. 52	1. 37	+2	2, 206, 202	2, 010, 533	−9
Missouri	5	5	6, 778, 384	7, 881, 118	+16	6, 929, 229	11, 117, 047	7, 943, 367	12, 367, 018	1. 60	1. 56	+15	957, 053	894, 804	−7
Ohio	10	10	8, 853, 869	9, 233, 033	+4	8, 727, 879	14, 242, 901	9, 364, 338	14, 928, 183	1. 63	1. 59	+7	1, 205, 379	1, 074, 074	−11
Pennsylvania	25	26	43, 732, 278	41, 522, 401	−5	42, 909, 513	66, 711, 069	41, 161, 019	62, 572, 588	1. 55	1. 52	−4	5, 868, 169	6, 229, 551	+6
Tennessee	5	6	4, 430, 439	4, 689, 703	+6	4, 343, 337	6, 580, 732	4, 634, 280	6, 322, 213	1. 52	1. 36	+7	515, 245	570, 668	+11
Texas	7	7	5, 655, 835	6, 345, 604	+12	5, 692, 350	10, 232, 908	6, 231, 083	10, 938, 646	1. 80	1. 76	+9	407, 403	521, 924	+28
Other States [1]	52	53	49, 032, 504	51, 494, 421	+5	48, 943, 103	81, 496, 364	50, 989, 514	83, 005, 760	1. 67	1. 63	+4	6, 526, 359	7, 031, 266	+8
	153	156	173, 206, 513	176, 298, 846	+2	171, 864, 728	278, 854, 647	175, 838, 332	275, 972, 945	1. 62	1. 57	+2	22, 457, 382	22, 917, 896	+2
DISTRICT															
Eastern Pennsylvania, New Jersey, and Maryland	24	25	42, 687, 200	39, 677, 010	−7	41, 656, 489	64, 614, 336	39, 738, 910	60, 236, 388	1. 55	1. 52	−5	5, 471, 989	5, 410, 089	−1
New York and Maine [2]	11	12	10, 775, 375	11, 484, 054	+7	10, 531, 092	16, 380, 090	11, 357, 052	17, 386, 416	1. 56	1. 53	+8	1, 528, 718	1, 655, 720	+8
Ohio, western Pennsylvania, and West Virginia	18	18	17, 339, 199	18, 326, 478	+6	17, 202, 341	27, 638, 726	18, 037, 131	28, 375, 472	1. 61	1. 57	+5	2, 571, 795	2, 861, 142	+11
Michigan	15	14	13, 965, 241	13, 848, 561	−1	13, 708, 259	20, 858, 202	14, 044, 230	19, 268, 707	1. 52	1. 37	+2	2, 206, 202	2, 010, 533	−9
Wisconsin, Illinois, Indiana, and Kentucky	11	11	22, 022, 150	22, 748, 604	+3	22, 394, 739	36, 274, 654	22, 627, 309	35, 575, 358	1. 62	1. 57	+1	2, 614, 241	2, 735, 536	+5
Virginia, Tennessee, Alabama, Georgia, Florida, and Louisiana	18	19	16, 016, 154	15, 949, 537	−. 4	15, 530, 338	23, 668, 315	15, 770, 338	21, 253, 288	1. 52	1. 35	+2	1, 680, 032	1, 859, 231	+11
Eastern Missouri, Iowa, Minnesota, and South Dakota	11	12	14, 358, 201	16, 692, 696	+16	14, 566, 818	23, 325, 158	16, 544, 026	25, 777, 858	1. 60	1. 56	+14	2, 731, 067	2, 879, 737	+5
Western Missouri, Nebraska, Kansas, and Oklahoma	11	11	10, 092, 888	10, 938, 637	+8	10, 250, 532	16, 809, 793	11, 221, 802	17, 444, 193	1. 64	1. 55	+9	1, 629, 230	1, 346, 065	−17
Texas	7	7	5, 655, 835	6, 345, 604	+12	5, 692, 350	10, 232, 908	6, 231, 083	10, 938, 646	1. 80	1. 76	+9	407, 403	521, 924	+28
Colorado, Montana, and Utah	8	7	2, 179, 241	2, 771, 863	+27	2, 293, 514	4, 692, 136	2, 628, 003	5, 698, 753	2. 05	2. 17	+15	380, 450	524, 310	+38
California	12	12	14, 580, 654	13, 555, 579	−7	14, 433, 153	26, 623, 396	13, 699, 851	25, 906, 942	1. 84	1. 89	−5	840, 506	696, 234	−17
Oregon and Washington	7	8	3, 534, 375	3, 960, 223	+12	3, 605, 103	7, 736, 933	3, 938, 597	8, 110, 924	2. 15	2. 06	+9	395, 749	417, 375	+5
	153	156	173, 206, 513	176, 298, 846	+2	171, 864, 728	278, 854, 647	175, 838, 332	275, 972, 945	1. 62	1. 57	+2	22, 457, 382	22, 917, 896	+2

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[1] Includes Colorado, Florida, Georgia, Indiana, Kentucky, Louisiana, Maine, Maryland, Minnesota, Montana, Nebraska, New Jersey, New York, Oklahoma, Oregon, South Dakota, Utah, Virginia, Washington, West Virginia, and Wisconsin.

[2] Maine began producing in April, 1928; shipping in May, 1928.

The following table, which shows production, shipments, and stocks of finished Portland cement by districts and by months for 1928, with totals by months for 1927, has been compiled from monthly reports on the operation of all but two plants each month; estimates have been included for the latter. Although the figures only approximate the totals shown by other tables, which are based on final annual reports from the producers, they reflect accurately the fluctuations in the industry during the year. In December, January, and February, in the colder part of the United States, the production of Portland cement is necessarily somewhat curtailed by the weather, as are also demand and hence shipments from the mills. In addition, mills often close for repairs during the winter, when the demand is lowest. As the quantity of clinker, unground cement, produced and in reserve at the mills awaiting manufacture into finished cement is of interest, the table appended shows these statistics, compiled from estimates by the manufacturers.

Summary of monthly estimates of Portland cement produced, shipped, and in stock at mills in the United States in 1928, by districts, in thousands of barrels

District	January	February	March	April	May	June	July	August	September	October	November	December
PRODUCTION												
Eastern Pennsylvania, New Jersey, and Maryland	2,351	2,135	2,512	3,084	3,823	4,065	3,832	4,024	3,610	3,743	3,338	2,760
New York and Maine [1]	549	305	587	831	1,291	1,208	1,207	1,320	1,205	1,204	962	812
Ohio, western Pennsylvania, and West Virginia	752	978	851	1,321	1,812	1,720	1,843	2,047	2,276	2,120	1,587	1,029
Michigan	379	303	560	1,056	1,280	1,456	1,662	1,614	1,573	1,550	1,409	1,058
Wisconsin, Illinois, Indiana, and Kentucky	1,354	901	933	1,438	2,384	2,446	2,375	2,548	2,411	2,238	1,973	1,683
Virginia, Tennessee, Alabama, Georgia, Florida, and Louisiana	1,109	1,037	1,268	1,381	1,337	1,391	1,414	1,508	1,433	1,561	1,413	1,084
Eastern Missouri, Iowa, Minnesota, and South Dakota	1,107	747	687	1,142	1,766	1,715	1,736	1,901	1,735	1,599	1,283	1,269
Western Missouri, Nebraska, Kansas, and Oklahoma	476	487	645	906	1,188	1,055	1,027	1,181	1,201	1,190	884	691
Texas	463	460	552	557	531	540	561	519	544	617	529	472
Colorado, Montana, and Utah	176	108	160	200	311	275	260	290	321	199	238	206
California	939	1,164	1,171	1,254	1,175	1,206	1,124	1,288	1,124	1,177	1,173	909
Oregon and Washington	113	172	297	298	410	420	433	519	451	335	279	216
United States, 1928	9,768	8,797	10,223	13,468	17,308	17,497	17,474	18,759	17,884	17,533	15,068	12,189
1927	8,258	7,377	11,450	14,048	16,701	17,224	17,408	18,315	17,505	17,174	14,449	11,999
SHIPMENTS												
Eastern Pennsylvania, New Jersey, and Maryland	1,545	1,456	2,396	3,303	4,200	4,081	4,042	4,403	4,141	4,753	3,153	1,963
New York and Maine [1]	316	288	499	850	1,239	1,264	1,428	1,519	1,355	1,375	725	495
Ohio, western Pennsylvania, and West Virginia	453	487	834	1,154	1,898	1,759	2,172	2,687	2,559	2,294	1,133	606
Michigan	300	319	505	846	1,507	1,731	1,872	2,070	1,991	1,673	811	416
Wisconsin, Illinois, Indiana, and Kentucky	519	578	1,004	1,670	2,793	2,443	2,863	3,076	3,085	2,646	1,272	644
Virginia, Tennessee, Alabama, Georgia, Florida, and Louisiana	938	922	1,298	1,276	1,500	1,409	1,419	1,699	1,475	1,576	1,350	870
Eastern Missouri, Iowa, Minnesota, and South Dakota	276	319	730	1,154	2,143	2,109	2,323	2,372	2,236	1,705	777	359
Western Missouri, Nebraska, Kansas, and Oklahoma	451	495	829	803	1,181	1,058	1,227	1,312	1,270	1,361	726	507
Texas	447	423	562	538	610	573	603	623	520	552	451	375
Colorado, Montana, and Utah	67	85	174	217	267	299	291	364	316	282	145	68
California	1,111	1,016	1,082	1,184	1,235	1,255	1,192	1,294	1,102	1,257	1,103	914
Oregon and Washington	118	175	222	312	413	440	469	551	410	362	305	167
United States, 1928	6,541	6,563	10,135	13,307	18,986	18,421	19,901	21,970	20,460	19,836	11,951	7,384
1927	5,968	6,731	11,100	14,350	16,865	19,761	18,984	21,411	19,828	18,105	11,619	6,200

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[1] Maine began producing in April, 1928; shipping in May, 1928.

Summary of monthly estimates of Portland cement produced, shipped, and in stock at mills in the United States in 1928, by districts, in thousands of barrels—Continued

District	January	February	March	April	May	June	July	August	September	October	November	December
STOCKS (END OF MONTH)												
Eastern Pennsylvania, New Jersey, and Maryland	5,886	6,566	6,682	6,488	6,153	6,131	5,913	5,524	4,987	4,011	4,251	5,410
New York and Maine [1]	1,761	1,778	1,866	1,847	1,899	1,843	1,622	1,423	1,273	1,102	1,339	1,656
Ohio, western Pennsylvania, and West Virginia	2,903	3,393	3,411	3,577	3,482	3,434	3,096	2,447	2,159	1,985	2,439	2,861
Michigan	2,221	2,205	2,260	2,467	2,240	1,955	1,748	1,297	879	757	1,355	2,011
Wisconsin, Illinois, Indiana, and Kentucky	3,409	3,732	3,661	3,429	3,011	3,004	2,506	1,967	1,283	924	1,629	2,736
Virginia, Tennessee, Alabama, Georgia, Florida, and Louisiana	1,851	1,966	1,935	2,040	1,888	1,872	1,867	1,676	1,634	1,619	1,683	1,859
Eastern Missouri, Iowa, Minnesota, and South Dakota	3,527	3,955	3,912	3,901	3,524	3,131	2,544	2,073	1,572	1,466	1,972	2,880
Western Missouri, Nebraska, Kansas, and Oklahoma	1,655	1,647	1,463	1,566	1,573	1,570	1,370	1,222	1,164	993	1,150	1,346
Texas	423	460	450	468	389	356	314	257	281	346	424	522
Colorado, Montana, and Utah	473	496	482	465	510	486	456	382	387	304	398	524
California	616	764	860	929	869	820	752	746	768	687	757	696
Oregon and Washington	391	387	463	450	446	427	392	360	412	385	372	417
United States, 1928	25,116	27,349	27,445	27,627	25,984	25,029	22,580	19,374	16,799	14,579	17,769	22,918
1927	22,914	23,563	23,922	23,654	23,503	20,972	19,397	16,292	13,996	13,141	16,022	[2] 22,457

[1] Maine began producing in April, 1928; shipping in May, 1928.
[2] Revised figures.

Summary of monthly estimates of clinker (unground Portland cement) produced and in stock at mills in the United States in 1928, by districts, in thousands of barrels

District	January	February	March	April	May	June	July	August	September	October	November	December	Year
PRODUCTION													
Eastern Pennsylvania, New Jersey, and Maryland	2,727	2,613	2,939	3,067	3,650	3,665	3,662	3,680	3,280	3,265	3,151	2,893	38,592
New York and Maine [1]	744	552	750	924	1,192	1,152	1,159	1,146	1,101	1,103	1,035	976	11,834
Ohio, western Pennsylvania, and West Virginia	1,062	1,156	1,124	1,411	1,686	1,727	1,537	1,632	1,748	1,856	1,568	1,352	17,859
Michigan	773	664	908	1,048	1,270	1,270	1,310	1,305	1,260	1,303	1,291	1,242	13,644
Wisconsin, Illinois, Indiana, and Kentucky	1,671	1,787	1,662	1,491	1,857	1,916	1,984	2,014	2,073	2,122	2,029	1,815	22,421

Virginia, Tennessee, Alabama, Georgia, Florida, and Louisiana	1, 247	1, 140	1, 226	1, 397	1, 247	1, 365	1, 385	1, 375	1, 401	1, 445	1, 409	1, 150	15, 787
Eastern Missouri, Iowa, Minnesota, and South Dakota	1, 224	1, 005	913	1, 198	1, 596	1, 584	1, 628	1, 694	1, 519	1, 444	1, 325	1, 352	16, 482
Western Missouri, Nebraska, Kansas, and Oklahoma	629	621	666	998	1, 098	1, 031	1, 039	1, 089	1, 095	1, 089	915	747	11, 017
Texas	418	455	544	556	546	479	561	539	557	570	540	483	6, 248
Colorado, Montana, and Utah	161	136	212	206	285	256	229	220	309	222	243	229	2, 708
California	989	1, 004	1, 180	1, 187	1, 243	1, 137	1, 096	1, 106	1, 201	1, 089	1, 157	960	13, 349
Oregon and Washington	194	230	377	361	355	358	391	402	365	274	267	227	3, 801
United States, 1928	11, 839	11, 363	12, 501	13, 844	16, 025	15, 940	15, 981	16, 202	15, 909	15, 782	14, 930	13, 426	173, 742
1927	10, 410	9, 253	12, 397	14, 246	15, 677	15, 437	15, 697	16, 396	15, 931	16, 469	14, 698	13, 177	169, 788
STOCKS (END OF MONTH)													
Eastern Pennsylvania, New Jersey, and Maryland	1, 241	1, 645	1, 948	2, 000	2, 267	1, 941	1, 840	1, 561	1, 296	867	702	911	----------
New York and Maine [1]	603	855	1, 023	1, 125	1, 042	995	963	799	706	627	724	898	----------
Ohio, western Pennsylvania, and West Virginia	1, 417	1, 607	1, 890	1, 998	1, 903	1, 938	1, 663	1, 284	781	530	528	896	----------
Michigan	1, 157	1, 525	1, 880	1, 881	1, 879	1, 699	1, 357	1, 057	758	527	440	659	----------
Wisconsin, Illinois, Indiana, and Kentucky	835	1, 727	2, 457	2, 515	2, 012	1, 506	1, 139	631	320	217	283	429	----------
Virginia, Tennessee, Alabama, Georgia, Florida, and Louisiana	910	1, 025	995	1, 029	964	956	966	848	827	719	722	789	----------
Eastern Missouri, Iowa, Minnesota, and South Dakota	603	866	1, 096	1, 162	1, 011	900	812	626	430	292	350	475	----------
Western Missouri, Nebraska, Kansas, and Oklahoma	396	535	559	657	580	563	580	496	398	303	338	396	----------
Texas	141	145	149	157	179	94	102	128	149	112	131	148	----------
Colorado, Montana, and Utah	356	385	442	447	421	402	373	303	292	315	321	345	----------
California	1, 544	1, 392	1, 410	1, 349	1, 437	1, 373	1, 371	1, 193	1, 273	1, 156	1, 143	1, 198	----------
Oregon and Washington	469	530	614	682	634	577	541	431	336	279	271	278	----------
United States, 1928	9, 672	12, 237	14, 463	15, 002	14, 329	12, 944	11, 707	9, 357	7, 566	5, 944	5, 953	7, 422	----------
1927	9, 989	11, 943	12, 997	13, 335	12, 514	10, 926	9, 609	7, 887	6, 490	5, 960	6, 374	7, 660	----------

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[1] Maine began producing in April, 1928; shipping in May, 1928.

The stock of Portland cement reported on hand at the mills increased each month in 1928 over the corresponding month in the preceding year. This is also true of 1927 as compared with 1926, except in September, October, and November, when there were slight decreases. The stock at the end of 1928 was 2 per cent higher than at the end of 1927 and was greater than at the end of any year during which official records of stock have been kept; it exceeded the average for the five preceding years (17,299,615 barrels) by more than 32 per cent. The totals by States and districts are given in the preceding tables.

Finished Portland cement in stock at mills in the United States, December 31, 1919–1928, in barrels

1919	5, 256, 900	1924	14, 151, 695
1920	8, 833, 067	1925	18, 336, 173
1921	12, 192, 567	1926	20, 740, 187
1922	9, 352, 250	1927	[2] 22, 457, 382
1923	10, 812, 639	1928	22, 917, 896

DOMESTIC CONSUMPTION

The total consumption of Portland cement in the United States may be estimated by adding the imports to the shipments and subtracting the exports from the sum. Of course, at any time a variable but considerable quantity of cement is in transit, in warehouses at distributing points, and awaiting use at jobs, so that the estimate thus made is at best only approximate. Another fact that impairs the accuracy of the estimate is that the cement imported and exported is classed as hydraulic cement; hence the records do not discriminate between Portland and other cements and probably include some plaster also. Portland cement, however, constitutes by far the greater part of the exports. The apparent domestic consumption in 1928 showed an increase of 2 per cent as compared with the consumption in 1927.

Portland cement available for consumption in the United States, 1919–1928, in barrels

Year	Shipments	Imports	Exports	Available for consumption
1919	85, 612, 899	8, 931	2, 463, 573	83, 158, 257
1920	96, 311, 719	524, 604	2, 985, 807	93, 850, 516
1921	95, 507, 147	122, 322	1, 181, 014	94, 448, 455
1922	117, 701, 216	323, 823	1, 127, 845	116, 897, 194
1923	135, 912, 118	1, 678, 636	1, 001, 688	136, 589, 066
1924	146, 047, 549	2, 010, 936	878, 543	147, 179, 942
1925	157, 295, 212	3, 655, 317	1, 019, 597	159, 930, 932
1926	162, 187, 090	3, 232, 386	974, 326	164, 445, 150
1927	171, 864, 728	2, 050, 180	816, 726	173, 098, 182
1928	175, 838, 332	2, 284, 085	824, 656	177, 297, 761

The only available gage of consumption of Portland cement by States is the record of shipments into the several States by the manufacturers and is therefore merely approximate. The shipments of cement into a State during a year do not equal the consumption in that State during the same year, but shipments over a long period should afford a fair index of consumption. The simplest available common unit is the estimated consumption in barrels per capita, which is obtained by comparing the shipments into the several States with the population of those States. The following table shows such figures for 1927 and 1928. The estimates of population used in calculating the per capita consumption are those of the Bureau of the Census.

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[2] Revised figures.

The official figures for exports of cement on page 371 differ from the exports reported by manufacturers in the following table, because cement forwarded from mills and destined for foreign countries and for Alaska, Hawaii, and Porto Rico is reported by the shipper as exported, whether or not it leaves the country during the calendar year; but the Bureau of Foreign and Domestic Commerce export figures record the cement that actually leaves the country during the period specified. (Shipments to Alaska, Hawaii, and Porto Rico appear on p. 371.) The exports for 1928 recorded by that bureau include all other hydraulic cement exported, whereas the table of per capita consumption relates only to Portland cement.

The per capita consumption indicated by the table necessarily falls short of the total apparent consumption by the quantity of the imports. These increase the consumption in certain States near the Canadian border and the seaboard; in 1928 they increased the general average per capita consumption by about 0.019 barrel.

In 28 States—17 east and 11 west of the Mississippi River—the per capita consumption in 1928 was 1 barrel or more. Three southern States—Alabama, Tennessee, and Texas—are included in this class.

The highest per capita consumption in 1928 was that of California—2.73 barrels. This State was also in the lead in 1927. Michigan, with 2.57 barrels, came second, as in 1927. In three other States—Illinois, New Jersey, and Iowa—the per capita consumption in 1928 was 2 barrels or more. Iowa and Vermont, in the order named, as in 1927, showed the largest per capita increases of the year. Next in order came Montana, Illinois, South Carolina, and Alabama. There were changes in all the States; 28 showed increases and 21 decreases. The general average consumption for the United States was 1.46 barrels in 1928, as compared with 1.44 in 1927. The range from 1914 to 1927 was from 0.64 barrel in 1918 to 1.44 barrels in 1927.

Shipments of domestic Portland cement from mills into States and per capita, 1927–28, in barrels [1]

State	1927		1928	
	Total	Per capita [1]	Total	Per capita [1]
Alabama	2, 264, 576	0. 89	2, 949, 527	1. 15
Arizona [2]	562, 460	1. 23	692, 754	1. 46
Arkansas [2]	855, 051	. 44	1, 251, 341	. 64
California	13, 128, 911	2. 96	12, 453, 852	2. 73
Colorado	1, 002, 396	. 93	1, 064, 945	. 98
Connecticut [2]	2, 061, 892	1. 26	2, 283, 726	1. 37
Delaware [2]	342, 905	1. 41	348, 719	1. 43
District of Columbia [2]	981, 732	1. 82	889, 674	1. 61
Florida	2, 482, 725	1. 82	1, 325, 921	. 94
Georgia	1, 904, 685	. 60	1, 742, 530	. 54
Idaho [2]	311, 226	. 58	294, 925	. 54
Illinois	14, 832, 550	2. 03	17, 683, 269	2. 39
Indiana	5, 738, 557	1. 82	5, 297, 337	1. 67
Iowa	3, 708, 471	1. 53	5, 348, 807	2. 20
Kansas	2, 432, 055	1. 33	2, 341, 459	1. 28
Kentucky	1, 953, 629	. 77	1, 740, 245	. 68

[1] Per capita figures based on estimate of population made by the Bureau of the Census.

[2] Noncement-producing State.

Shipments of domestic Portland cement from mills into States and per capita, 1927–28, in barrels—Continued

State	1927		1928	
	Total	Per capita	Total	Per capita
Louisiana	1,490,560	0.77	1,276,127	0.65
Maine [3]	505,952	.64	522,573	.66
Maryland	2,651,700	1.66	2,242,541	1.39
Massachusetts [2]	2,820,132	.66	2,916,526	.68
Michigan	11,576,188	2.58	11,776,282	2.57
Minnesota	3,380,002	1.26	3,054,583	1.12
Mississippi [2]	980,791	.55	1,128,613	.63
Missouri	4,207,151	1.20	4,718,602	1.34
Montana	307,968	.43	461,299	.84
Nebraska	1,360,032	.97	1,195,650	.85
Nevada [2]	87,276	1.13	106,321	1.37
New Hampshire [2]	459,706	1.01	515,317	1.13
New Jersey	8,419,323	2.25	8,436,886	2.21
New Mexico [2]	278,528	.71	333,250	.84
New York	23,002,585	2.01	22,325,087	1.93
North Carolina [2]	3,213,314	1.11	2,401,733	.82
North Dakota [2]	392,730	.61	454,873	.71
Ohio	10,342,424	1.54	11,017,572	1.61
Oklahoma	3,119,565	1.31	3,125,602	1.29
Oregon	1,399,167	1.57	1,257,195	1.39
Pennsylvania	13,837,359	1.42	12,996,626	1.32
Rhode Island [2]	700,851	1.00	760,813	1.06
South Carolina [2]	985,874	.53	1,508,279	.81
South Dakota	409,820	.59	491,102	.70
Tennessee	2,262,697	.91	2,699,338	1.08
Texas	5,437,907	1.01	6,193,925	1.13
Utah	428,469	.82	507,986	.96
Vermont [2]	393,294	1.12	605,930	1.72
Virginia	1,799,062	.71	1,995,529	.77
Washington	2,574,293	1.65	2,974,407	1.87
West Virginia	1,561,978	.92	1,360,597	.79
Wisconsin	5,553,176	1.90	5,382,421	1.82
Wyoming [2]	181,103	.75	198,194	.80
Unspecified	51,818		29,916	
	170,736,616	1.44	174,680,726	1.46
Exports reported by manufacturers but not included above [4]	1,128,112		1,157,606	
Total shipped from cement plants	171,864,728		175,838,332	

[2] Noncement-producing State.
[3] Maine began producing in April, 1928; shipping in May, 1928.
[4] Includes shipments to Alaska, Hawaii, and Porto Rico.

The following table, which shows by months during 1928 the shipments from Portland-cement mills into States, has been compiled from monthly reports of producers, but includes estimates of the distribution of shipments from three plants each month. Although the figures only approximate the totals shown in the other tables, which are based on final annual reports from the producers, they reflect the fluctuations in shipments during the year.

Portland cement shipped from mills into States in 1928, by months, in barrels [1]

Shipped to—	January	February	March	April	May	June
Alabama	235,233	254,968	282,379	233,865	294,946	218,443
Alaska	396	928	264	542	588	1,179
Arizona	82,184	72,365	81,586	64,808	23,982	45,357
Arkansas	62,143	76,288	101,428	86,513	120,605	94,530
California	1,030,965	909,617	937,253	1,058,739	1,101,338	1,135,923
Colorado	32,389	33,593	60,381	90,312	122,205	134,040
Connecticut	74,600	52,401	113,752	187,697	273,367	274,577
Delaware	13,077	11,304	19,230	26,177	35,361	31,076
District of Columbia	30,341	55,069	62,160	66,108	66,508	77,565
Florida	108,750	105,590	114,798	134,647	90,435	101,132
Georgia	113,857	97,616	157,171	155,787	167,422	151,318
Hawaii	20,290	26,923	39,411	19,314	29,807	19,441
Idaho	6,408	11,020	23,994	30,832	35,009	31,940
Illinois	354,763	401,092	700,881	1,192,251	2,087,924	1,921,820
Indiana	88,411	102,747	232,338	355,434	568,668	513,118
Iowa	30,488	41,520	149,705	405,654	929,356	790,414
Kansas	78,460	107,291	194,957	202,705	250,076	203,747

[1] Includes estimated distribution of shipments from 3 plants each month.

Portland cement shipped from mills into States in 1928, by months, in barrels—Con.

Shipped to—	January	February	March	April	May	June
Kentucky	54,991	52,748	103,113	130,168	178,020	155,438
Louisiana	94,929	97,484	115,669	112,667	110,257	107,624
Maine	12,487	10,738	18,704	30,015	49,458	69,190
Maryland	87,650	66,413	123,334	176,807	250,926	240,228
Massachusetts	104,382	100,548	160,730	256,150	306,685	314,595
Michigan	267,206	287,114	433,110	710,731	1,218,783	1,393,059
Minnesota	50,480	49,334	128,332	185,901	446,443	490,086
Mississippi	57,528	50,677	73,937	73,651	89,421	90,654
Missouri	146,411	170,275	333,221	383,704	473,066	388,090
Montana	8,289	10,578	27,231	32,676	50,054	57,263
Nebraska	26,815	33,967	88,491	108,224	131,720	132,088
Nevada	3,293	4,524	7,568	7,195	11,050	10,583
New Hampshire	17,647	18,066	25,575	34,667	48,034	52,334
New Jersey	318,204	296,641	505,016	778,746	899,439	836,204
New Mexico	12,861	21,302	30,606	27,664	30,612	32,989
New York	800,428	768,681	1,237,218	1,758,888	2,414,892	2,369,486
North Carolina	135,292	100,830	209,006	199,340	259,658	253,034
North Dakota	2,102	2,641	18,274	34,627	69,986	89,107
Ohio	265,048	298,885	540,347	776,992	1,263,450	1,111,149
Oklahoma	201,422	203,245	294,206	209,850	307,249	271,078
Oregon	37,133	74,793	78,121	102,480	143,000	132,565
Pennsylvania	441,419	404,956	657,006	928,060	1,396,046	1,303,841
Porto Rico	----------	----------	1,329	----------	500	----------
Rhode Island	25,325	18,701	47,707	81,029	93,304	81,651
South Carolina	102,178	75,677	119,612	101,838	141,083	174,819
South Dakota	5,988	10,434	25,694	42,599	65,137	81,989
Tennessee	88,966	109,112	174,774	216,928	274,229	231,638
Texas	405,245	383,884	546,960	526,063	601,278	563,118
Utah	9,575	15,131	35,955	36,932	38,520	50,931
Vermont	11,363	15,902	14,737	27,791	43,912	67,482
Virginia	91,941	104,674	173,697	175,192	201,315	198,998
Washington	90,604	128,568	162,335	237,749	315,209	342,740
West Virginia	39,992	44,944	81,273	103,682	151,015	126,545
Wisconsin	74,881	91,829	148,969	287,693	615,376	728,674
Wyoming	5,262	8,427	13,571	15,229	18,033	22,174
Unspecified	32,918	22,737	57,761	41,738	27,702	36,666
	6,493,010	6,514,792	10,084,877	13,265,051	18,932,459	18,353,730
Foreign countries	47,990	48,208	50,123	41,949	53,541	67,270
Total shipped from cement plants	6,541,000	6,563,000	10,135,000	13,307,000	18,986,000	18,421,000

Shipped to—	July	August	September	October	November	December
Alabama	267,843	315,341	255,120	226,835	192,012	123,522
Alaska	1,496	382	277	132	264	132
Arizona	42,336	57,033	56,940	60,063	56,742	42,385
Arkansas	123,490	150,173	136,794	126,798	99,304	69,131
California	1,081,470	1,166,958	1,020,406	1,145,337	1,025,113	859,234
Colorado	113,414	147,267	140,150	114,600	52,084	24,317
Connecticut	266,888	279,631	233,257	259,374	161,388	97,419
Delaware	35,077	29,447	34,578	73,582	25,357	14,122
District of Columbia	87,606	83,553	81,703	133,450	88,507	53,681
Florida	97,376	105,108	98,859	142,911	117,845	97,857
Georgia	135,770	181,254	155,421	180,537	146,394	98,912
Hawaii	21,832	25,413	21,378	34,436	22,593	20,659
Idaho	40,823	45,284	30,886	28,253	17,765	5,533
Illinois	2,321,485	2,581,921	2,553,958	2,127,381	930,003	469,527
Indiana	712,107	804,868	847,440	658,331	258,523	133,155
Iowa	873,528	813,328	738,450	442,740	96,294	34,397
Kansas	215,125	233,127	272,461	316,943	167,928	93,623
Kentucky	192,746	216,674	211,690	203,725	146,416	63,567
Louisiana	113,049	125,319	112,202	106,819	104,808	74,396
Maine	63,915	71,721	79,289	72,694	30,175	11,944
Maryland	246,605	260,189	227,573	307,849	157,297	90,219
Massachusetts	334,822	308,837	315,939	337,880	224,846	136,456
Michigan	1,540,219	1,707,324	1,692,432	1,449,956	728,972	368,112
Minnesota	435,564	401,260	377,096	306,698	124,063	52,903
Mississippi	90,937	122,486	129,970	133,253	124,113	90,745
Missouri	484,207	541,927	554,767	583,508	364,782	193,691
Montana	58,225	66,954	59,124	52,977	25,857	11,889
Nebraska	110,938	127,833	159,659	174,041	67,962	32,472
Nevada	10,535	14,101	13,635	9,954	9,566	4,029
New Hampshire	46,025	69,903	72,947	73,003	37,083	19,477
New Jersey	861,340	878,977	884,759	1,064,536	690,435	383,075
New Mexico	36,795	43,079	27,552	37,837	21,301	15,068
New York	2,480,799	2,774,981	2,398,193	2,445,879	1,565,942	1,150,410
North Carolina	221,912	218,950	167,910	238,528	248,290	148,245
North Dakota	72,490	61,931	43,739	41,390	14,375	4,237
Ohio	1,313,568	1,549,784	1,410,196	1,312,086	707,863	351,927
Oklahoma	285,643	286,023	361,360	314,273	238,178	220,102
Oregon	140,619	175,733	132,521	120,863	65,960	39,466
Pennsylvania	1,437,571	1,699,137	1,519,073	1,651,472	958,080	539,402
Porto Rico	----------	----------	500	----------	500	----------
Rhode Island	68,980	71,291	77,316	87,953	61,403	43,188

Portland cement shipped from mills into States in 1928, by months, in barrels—Con.

Shipped to—	July	August	September	October	November	December
South Carolina	149,917	152,387	108,575	154,004	135,037	92,059
South Dakota	61,429	62,440	58,274	52,621	17,271	6,722
Tennessee	288,860	323,794	353,282	344,413	257,552	138,090
Texas	601,154	690,901	515,419	564,578	447,090	379,921
Utah	58,462	65,376	49,468	51,793	29,404	15,132
Vermont	64,211	103,293	108,095	107,388	31,272	11,026
Virginia	183,762	214,602	173,104	220,617	148,508	97,175
Washington	361,159	408,566	291,994	261,412	243,351	132,183
West Virginia	151,406	166,289	166,816	170,134	94,931	46,917
Wisconsin	812,237	809,545	791,171	622,618	258,637	114,658
Wyoming	21,154	30,976	27,555	17,682	11,987	4,428
Unspecified	2,209	30,779	41,593	11,413	32,678	502
	19,841,130	21,873,450	20,392,866	19,777,550	11,884,101	7,321,439
Foreign countries	59,870	96,550	67,134	58,450	66,899	62,561
Total shipped from cement plants	19,901,000	21,970,000	20,460,000	19,836,000	11,951,000	7,384,000

LOCAL SUPPLIES

The following table compares the shipments from the mills within a State or group of States with the estimated consumption (State receipts of mill shipments) and indicates the surplus or deficiency in the supply of cement locally available. Consumption in the States that do not produce cement is also indicated in the table on page 353. Data for 1916 to 1926 will be found in Mineral Resources of the United States for 1917 to 1926.

The surplus shown in the following table was distributed by years, as follows: In 1927, to noncement-producing States, 16,114,817 barrels; to foreign countries and to Alaska, Hawaii, and Porto Rico, 1,128,112 barrels; unspecified, 51,818 barrels. In 1928, to noncement-producing States, 16,690,988 barrels; to foreign countries and to Alaska, Hawaii, and Porto Rico, 1,157,606 barrels; unspecified, 29,916 barrels.

Estimated surplus or deficiency in local supply of Portland cement in cement-producing States, 1927–28, in barrels

State or division	1927			1928		
	Shipments from mills	Estimated consumption	Surplus or deficiency	Shipments from mills	Estimated consumption	Surplus or deficiency
Alabama	7,313,494	2,264,576	+5,048,918	6,696,684	2,949,527	+3,747,157
California	14,433,153	13,128,911	+1,304,242	13,699,851	12,453,852	+1,245,999
Illinois	7,061,240	14,832,550	−7,771,310	7,405,667	17,683,269	−10,277,602
Iowa	5,661,234	3,708,471	+1,952,763	6,880,731	5,348,807	+1,531,924
Kansas	6,141,937	2,432,055	+3,709,882	6,787,568	2,341,459	+4,446,109
Michigan	13,708,259	11,576,188	+2,132,071	14,044,230	11,776,282	+2,267,948
Missouri	6,929,229	4,207,151	+2,722,078	7,943,367	4,718,602	+3,224,765
Ohio	8,727,879	10,342,424	−1,614,545	9,364,338	11,017,572	−1,653,234
Pennsylvania	42,909,513	13,837,359	+29,072,154	41,161,019	12,996,626	+28,164,393
Tennessee	4,343,337	2,262,697	+2,080,640	4,634,280	2,699,338	+1,934,942
Texas	5,692,350	5,437,907	+254,443	6,231,083	6,193,925	+37,158
Colorado, Montana, and Utah	2,293,514	1,738,833	+554,681	2,628,003	2,034,230	+593,773
Oregon and Washington	3,605,103	3,973,460	−368,357	3,938,597	4,231,602	−293,005
Georgia, Kentucky, Virginia, Florida, and Louisiana	4,742,235	9,630,661	−4,888,426	5,283,676	8,080,352	−2,796,676
Indiana, Wisconsin, Minnesota, Nebraska, Oklahoma, and South Dakota	20,549,721	19,561,152	+988,569	20,531,502	18,546,695	+1,984,807
Maryland, New Jersey, and West Virginia	7,221,438	12,633,001	−5,411,563	7,250,684	12,040,024	−4,789,340
New York and Maine[1]	10,531,092	23,002,585	−12,471,493	11,357,052	22,847,660	−11,490,608
	171,864,728	154,569,981	+17,294,747	175,838,332	157,959,822	+17,878,510

Maine began producing in April, 1928; shipping in May, 1928.

BULK SHIPPING

In consideration of the reported increasing shipment of Portland cement in bulk from the mills, the installment of equipment at various plants facilitating the loading of loose cement direct from the plant into railroad car or other carrier, and the building at the larger cities or at convenient distributing points by the cement companies of silos and warehouses provided with facilities for the receipt, storage, and sacking of loose cement, the Bureau of Mines made a canvass to ascertain the extent to which bulk shipments were made from the mills during 1928.

Reports from the producers show that 4,179,460 barrels (785,738 short tons) or 2.4 per cent of the total mill shipments in 1928 were bulk shipments; 3,998,188 barrels or 2.3 per cent of the total shipments were in railroad cars and 181,272 barrels or 0.1 per cent of the total were by truck or boat, as compared with 97.6 per cent of the total shipped from the mills in containers. Companies reported bulk shipments from 71 plants in 19 States in 1928; 65 plants shipped thus by rail and 12 by truck or boat. Reports from plants making bulk shipments showed a range in shipments by this method from less than 1 per cent to 40 per cent of the total plant shipments.

It is reported that plants located with access to waterways are doing considerable building of barges and boats equipped with bag-packing apparatus and with special systems for loading and unloading bulk cement.

PRICES

AT FACTORIES

The average selling value of Portland cement f. o. b. at the factories, with the price of containers not included and with cash discounts deducted where allowed, as reported to the Bureau of Mines is shown in the table of shipments by States and districts during 1927 and 1928 (p. 347). The averages by districts ranged from $1.35 a barrel in the Virginia-Tennessee-Alabama-Georgia-Florida-Louisiana district to $2.17 a barrel in the Colorado-Montana-Utah district in 1928, as compared with a range from $1.52 a barrel in the Virginia-Tennessee-Alabama-Georgia-Florida-Louisiana and the Michigan districts to $2.15 a barrel in the Oregon-Washington district in 1927. The general average value for the country as a whole decreased 5 cents per barrel, or 3 per cent, in 1928, and averages were lower in all the districts except Colorado-Montana-Utah and California and in all the States shown in the table except California.

For certain States the average factory value of Portland cement may be higher than it would be if the ordinary structural cement were the only kind considered. For these States certain special cements that command higher prices are included in the average. These special cements include the white Portland cement made in Pennsylvania and, beginning in 1927, in Tennessee as well, and the plastic and waterproofed Portland cements. The manufacture in California of cement characterized as plastic and waterproof and intended particularly for certain uses, such as shutting out water in oil wells, has been noted for some years in previous issues of this report. In 1927, the first year for which an attempt was made by the Bureau of Mines to collect separate statistics of special Portland cements, the manufacture and marketing of cement of marked plasticity and waterproofing qualities was reported in a number of other States. Statistics of output of plastic and waterproofed, high-early strength, and quick-hardening Portland cement in 1927 and 1928 appear in the table on page 365.

Average factory value per barrel in bulk of Portland cement, 1917–1928

1917	$1. 35	1921	$1. 89	1925	$1. 77
1918	1. 60	1922	1. 76	1926	1. 71
1919	1. 71	1923	1. 90	1927	1. 62
1920	2. 02	1924	1. 81	1928	1. 57

AT MARKETS

The following table summarizes the wholesale prices of Portland cement in bulk in carload lots at the principal cities of the United States and at Montreal, Canada, for 1927 and 1928, by months, as published in the Engineering News-Record. Seeming inconsistencies in the table, such as sudden large changes in prices, suggest the inclusion of delivery charges that the explanatory footnote does not account for.

As the annual per capita consumption of Portland cement in the United States has reached nearly 1½ barrels and promises to continue to increase, the prices of such an essential building material have attracted particular interest. Considerable information is now available to show the position of cement prices among those of other structural materials and to explain the economic conditions that determine them. Data of interest in this connection are now compiled and published by the United States Department of Labor, Bureau of Labor Statistics.

Wholesale prices of Portland cement per barrel in bulk in carload lots, 1927–28, by months [1]

City	January		February		March		April		May		June	
	1927	1928	1927	1928	1927	1928	1927	1928	1927	1928	1927	1928
Atlanta	$2. 35	$2. 45	$2. 25	$2. 45	$2. 35	$2. 15	$2. 35	$2. 30	$2. 35	$2. 30	$2. 35	$2. 30
Baltimore	2. 50	2. 50	2. 50	2. 50	2. 50	2. 50	2. 50	2. 54	2. 50	2. 65	2. 50	2. 65
Birmingham	2. 40	2. 40	2. 30	2. 40	2. 40	2. 40	2. 40	2. 60	2. 40	2. 60	2. 40	2. 60
Boston	2. 35	2. 05	2. 35	2. 05	2. 35	2. 05	2. 25	2. 25	2. 25	2. 25	2. 30	2. 25
Cedar Rapids	2. 24	2. 24	2. 24	2. 24	2. 24	2. 24	2. 24	2. 24	2. 24	2. 24	2. 24	2. 24
Chicago	2. 10	2. 05	2. 05	2. 05	2. 05	2. 05	2. 05	2. 05	2. 05	2. 05	2. 05	2. 05
Cincinnati	2. 37	2. 23	2. 32	2. 23	2. 32	2. 22	2. 32	2. 22	2. 32	2. 22	2. 32	2. 22
Cleveland	2. 29	2. 24	2. 24	2. 24	2. 24	2. 24	2. 24	2. 24	2. 24	2. 24	2. 24	2. 24
Dallas	2. 05	2. 05	2. 05	2. 05	2. 05	2. 05	2. 05	2. 40	2. 05	2. 40	2. 05	2. 40
Davenport	2. 29	2. 24	2. 24	2. 24	2. 24	2. 24	2. 24	2. 24	2. 24	2. 24	2. 24	2. 24
Denver	2. 85	2. 85	2. 85	2. 85	2. 85	2. 85	2. 85	2. 85	2. 85	2. 85	2. 85	2. 85
Detroit	2. 15	2. 00	2. 15	1. 90	2. 15	1. 90	2. 15	1. 90	2. 15	1. 90	2. 15	1. 90
Duluth	2. 09	2. 04	2. 04	2. 04	2. 04	2. 04	2. 04	2. 04	2. 04	2. 04	2. 04	2. 04
Indianapolis	2. 29	2. 19	2. 19	2. 19	2. 19	2. 19	2. 19	2. 19	2. 19	2. 19	2. 19	2. 19
Jersey City	2. 33	2. 13	2. 33	2. 13	2. 28	2. 13	2. 28	2. 13	2. 28	2. 35	2. 13	2. 35
Kansas City	2. 05	2. 07	2. 05	2. 10	2. 05	2. 10	2. 20	2. 50	2. 50	2. 50	2. 10	2. 40
Los Angeles	2. 50	2. 50	2. 50	2. 50	2. 50	2. 50	2. 50	2. 60	2. 50	2. 66	2. 56	2. 66
Milwaukee	2. 25	2. 20	2. 20	2. 20	2. 20	2. 20	2. 20	2. 20	2. 20	2. 20	2. 20	2. 20
Minneapolis	2. 22	2. 22	2. 22	2. 22	2. 22	2. 22	2. 22	2. 22	2. 22	2. 22	2. 22	2. 22
Montreal	1. 41	1. 41	1. 41	1. 41	1. 41	1. 41	1. 41	1. 41	1. 41	1. 41	1. 36	1. 41
New Orleans	2. 40	2. 07	2. 40	2. 07	2. 40	2. 07	2. 40	2. 50	2. 40	2. 50	2. 40	2. 40
New York (delivered)	2. 50- 2. 60	2. 25- 2. 35	2. 35- 2. 50	2. 25- 2. 35	2. 35- 2. 50	2. 25- 2. 35	2. 35- 2. 50	2. 25- 2. 35	2. 35- 2. 50	2. 25- 2. 35	2. 35- 2. 50	2. 25- 2. 35
New York (alongside dock to dealers)	2. 15	2. 03	2. 03	2. 03	2. 03	2. 03	2. 03	------	2. 03	------	2. 03	------
Peoria	2. 27	2. 22	2. 22	2. 22	2. 22	2. 22	2. 22	2. 22	2. 22	2. 22	2. 22	2. 22
Philadelphia	2. 50	2. 40	2. 50	2. 40	2. 50	2. 40	2. 50	2. 21	2. 50	2. 31- 2. 41	2. 40	2. 31- 2. 41
Pittsburgh	2. 09	2. 04	2. 04	2. 04	2. 04	2. 04	2. 04	2. 04	2. 04	2. 04	2. 04	2. 04
St. Louis	2. 20	2. 05	2. 05- 2. 20	2. 05	2. 05	2. 05	2. 05	2. 45	2. 05	2. 45	2. 05	2. 45
St. Paul	2. 22	2. 22	2. 22	2. 22	2. 22	2. 22	2. 22	2. 22	2. 22	2. 22	2. 22	2. 22
San Francisco	2. 31	2. 51	2. 31	2. 41	2. 31	2. 41	2. 51	2. 41	2. 51	2. 41	2. 51	2. 41
Seattle	2. 65	2. 65	2. 65	2. 65	2. 65	2. 65	2. 65	2. 65	2. 65	2. 70	2. 65	2. 70
Toledo	2. 20	2. 20	2. 20	2. 20	2. 20	2. 20	2. 20	2. 20	2. 20	2. 20	2. 20	2. 20

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[1] Engineering News-Record. Prices quoted are f. o. b. points listed, without bags; cash discount not deducted.

Wholesale prices of Portland cement per barrel in bulk in carload lots, 1927–28, by months—Continued

City	July		August		September		October		November		December	
	1927	1928	1927	1928	1927	1928	1927	1928	1927	1928	1927	1928
Atlanta	$2.40	$2.40	$2.40	$2.25	$2.40	$2.30	$2.40	$2.30	$2.45	$2.30	$2.45	$2.10
Baltimore	2.50	2.65	2.50	2.65	2.50	2.65	2.50	2.65	2.50	2.65	2.50	2.65
Birmingham	2.40	2.60	2.40	2.60	2.40	2.60	2.40	2.60	2.40	2.60	2.40	2.60
Boston	2.00	2.35	2.05	2.35	2.05	2.35	2.05	2.35	2.05	2.35	2.05	2.35
Cedar Rapids	2.24	2.24	2.24	2.24	2.24	2.24	2.24	2.24	2.24	2.24	2.24	2.24
Chicago	2.05	2.05	2.05	2.05	2.05	2.05	2.05	2.05	2.05	2.05	2.05	2.05
Cincinnati	2.32	2.22	2.32	2.22	2.32	2.22	2.32	2.22	2.32	2.22	2.32	2.22
Cleveland	2.24	2.24	2.24	2.24	2.24	2.24	2.24	2.24	2.24	2.24	2.24	2.24
Dallas	2.05	2.40	2.05	2.40	2.05	2.40	2.05	2.15	2.05	2.15	2.05	2.15
Davenport	2.24	2.24	2.24	2.24	2.24	2.24	2.24	2.24	2.24	2.24	2.24	2.24
Denver	2.85	2.85	2.85	2.85	2.85	2.85	2.85	2.55	2.85	2.55	2.85	2.55
Detroit	2.15	1.90	2.15	1.90	2.15	1.95	2.00	1.95	2.00	1.95	2.00	1.95
Duluth	2.04	2.04	2.04	2.04	2.04	2.04	2.04	2.04	2.04	2.04	2.04	2.04
Indianapolis	2.19	2.19	2.19	2.19	2.19	2.19	2.19	2.19	2.19	2.19	2.19	2.19
Jersey City	2.13	2.35	2.13	2.35	2.13	2.35	2.13	2.35	2.13	2.35	2.13	2.35
Kansas City	2.10	2.30	2.07	2.40	2.07	2.20	2.07	2.20	2.07	2.17	2.07	2.20
Los Angeles	2.56	2.66	2.56	2.66	2.56	2.66	2.56	2.66	2.56	2.66	2.56	2.66
Milwaukee	2.20	2.20	2.20	2.20	2.20	2.20	2.20	2.20	2.20	2.20	2.20	2.20
Minneapolis	2.22	2.22	2.22	2.22	2.22	2.22	2.22	2.22	2.22	2.22	2.22	2.22
Montreal	2.22	1.41	2.22	1.41	2.22	1.41	1.41	1.41	1.41	1.41	1.41	1.41
New Orleans	2.40	2.40	2.50	2.20	2.50	2.20	2.07	2.40	2.32	2.40	2.07	2.35
New York (delivered)	2.35– 2.50	2.25– 2.35	2.35	2.25– 2.35	2.35	2.25– 2.35	2.35	2.25– 2.35	2.35	2.25– 2.35	2.25– 2.35	2.25– 2.35
New York (alongside dock to dealers)	2.03	------	2.03	------	2.03	------	2.03	------	2.03	------	2.03	------
Peoria	2.22	2.22	2.22	2.22	2.22	2.22	2.22	2.22	2.22	2.22	2.22	2.22
Philadelphia	2.40	2.31– 2.41	2.40	2.31– 2.41	2.40	2.41	2.40	2.41	2.40	2.41	2.40	2.41
Pittsburgh	2.04	2.04	2.04	2.04	2.04	2.04	2.04	2.04	2.04	2.04	2.04	2.04
St. Louis	2.05	2.45	2.05	2.45	2.05	2.45	2.05	2.45	2.05	2.45	2.05	2.45
St. Paul	2.22	2.22	2.22	2.22	2.22	2.22	2.22	2.22	2.22	2.22	2.22	2.22
San Francisco	2.51	2.41	2.51	2.41	2.51	2.41	2.51	2.41	2.51	2.41	2.51	2.41
Seattle	2.65	2.70	2.65	2.70	2.65	2.70	2.65	2.70	2.65	2.70	2.65	2.70
Toledo	2.20	2.20	2.20	2.20	2.20	2.20	2.20	2.20	2.20	2.20	2.20	2.20

Comparative prices of building materials in December, 1927 and 1928 [1]

[Percentage of increase or decrease from 1926 average]

	1927	1928
Building materials in general	−9.6	−3.2
Lime, building, at plant (composite price)	−1.9	−5.8
Plate glass, 3 to 5 feet, New York	−12.1	−12.1
Turpentine, New York	−41.6	−34.7
Brick, common, building, at plant (composite price)	----------	−2.1
Linseed oil, raw, New York	−13.9	−9.6
Douglas fir, No. 1, common, at mills	−10.2	−.6
Yellow pine, flooring, at mills	−21.2	−17.6
Oak, plain white, No. 1, Cincinnati	−8.4	−9.1
Portland cement, at plant (composite price)	−3.5	−5.4

[1] U. S. Department of Labor, Bureau of Labor Statistics, Wholesale Prices of Commodities: Report for December, 1928, pp. 9–10.

MANUFACTURING CONDITIONS

PLANTS

Portland cement was manufactured at 155 plants and shipments were made from 156 plants in 1928, as compared with 153 producing and 152 shipping plants in 1927. Four new plants produced Portland cement in 1928, all of which are reported as wet-process plants. They were equipped at the end of 1928 as follows:

Lawrence Portland Cement Co., plant at Thomaston, Knox County, Me. Wet process: Limestone; clinker burned with coal; two 11 by 200 foot kilns; reported daily clinker capacity, 3,000 barrels.

Keystone Portland Cement Co., plant at Bath, Northampton County, Pa. Wet process: Limestone and cement rock; clinker burned with coal; two 10 to 13⅙ by 250 foot kilns; reported daily clinker capacity, 3,500 barrels.

Volunteer Portland Cement Co., plant at Caswell, Knox County, Tenn. Wet process: Limestone and shale; clinker burned with coal; two 10 by 215 foot kilns; reported daily clinker capacity, 3,000 barrels.

Northwestern Portland Cement Co., plant at Grotto, King County, Wash. Wet process: Limestone and clay; clinker burned with oil; one 11¼ by 240 foot kiln; reported daily clinker capacity, 2,000 barrels.

Additional plants were under construction but not completed in 1928 in Arkansas, Idaho, Nebraska, Pennsylvania, Texas, Washington, and Wyoming.

FUELS

The records show that 79.5 per cent of the Portland cement produced in 1928 was burned with coal alone, as compared with 80.4 per cent in 1927; that 7.4 per cent was burned with oil alone, as compared with 7.3 per cent in 1927; and that 2.8 per cent was burned with natural gas alone, as compared with 1.8 per cent in 1927.

As summarized from the reports of the cement producers, there were consumed at the Portland-cement plants in the United States in 1928, in the production of 176,298,846 barrels of finished cement, the following quantities of fuel: Coal, 9,802,431 short tons; oil, 3,508,038 barrels (or 147,337,596 gallons); and natural gas, 30,660,348,200 cubic feet. Corresponding figures from the producers' reports for 1927, the first year for which statistics of the quantities of fuels used in the industry were collected by the Bureau of Mines, are as follows: Finished cement produced, 173,206,513 barrels; fuels consumed in its manufacture—coal, 9,990,531 short tons; oil, 4,419,882 barrels (or 185,635,044 gallons); and natural gas, 23,640,250,515 cubic feet. In the estimates of consumption of fuel per barrel of cement the production of finished cement alone is considered. In this connection it is of interest that the stock of clinker, unground cement, at the mills at the end of 1928—7,422,000 barrels—as shown in the tables on pages 351 and 362, nearly offsets the stock of clinker at the mills at the end of 1927—7,660,000 barrels.

Coal was reported as the only fuel used at 124 plants in the United States in 1928, as compared with 123 plants reporting the consumption of this fuel only in 1927. The apparent average consumption in 1928 was 131.1 pounds of coal per barrel of finished cement, as compared with 135.8 pounds of coal per barrel of finished cement in 1927. The 64 dry-process plants using coal as the only fuel in 1928 reported a total consumption of 5,536,526 short tons of coal in the manufacture of 90,769,258 barrels of finished cement, or an average consumption of 122 pounds of coal per barrel of finished cement, as compared with the consumption in 1927 at 65 dry-process plants, where coal was reported as the only fuel used, of 5,983,141 short tons of coal in the manufacture of 94,606,073 barrels of finished cement, or an average consumption of 126.4 pounds of coal per barrel of finished cement.

Sixty wet-process plants reported the use of coal alone as fuel in 1928, with a total consumption of 3,650,394 short tons, in the manufacture of 49,335,412 barrels of finished cement, or an average consumption of 148 pounds of coal per barrel of finished cement. Fifty-eight wet-process plants using coal alone as fuel in 1927 reported a total consumption of 3,468,388 short tons of coal in the manufacture of 44,589,778 barrels of finished cement, or an average consumption of 155.6 pounds of coal per barrel of finished cement.

Thirteen plants, all in Pacific Coast States, reported the use of oil alone as fuel in 1928, with a total consumption of 3,263,537 barrels, in the manufacture of 13,078,031 barrels of finished cement, or an average of 0.2495 barrel (about 10½ gallons) per barrel of finished cement; in other words, 1 barrel of oil burned more than 4 barrels of cement. One of the plants in this group also reported some petroleum coke used as fuel. The average consumption of oil by the dry-process plants was 0.2369 barrel (or about 10 gallons) per barrel of finished cement, and by the wet-process plants 0.2660 barrel (11.2 gallons) per barrel of finished cement. The use of oil in 1928 was reported at 10 additional plants, which also used other fuel; 3 of these plants are east and 7 west of the Mississippi River. Thirteen plants reported the use of oil alone as fuel in 1927, with a total consumption of 3,480,426 barrels, in the manufacture of 12,686,167 barrels of finished cement, or an average of 0.2743 barrel (11½ gallons) of oil per barrel of cement; expressed in other terms, 1 barrel of oil burned 3.6 barrels of cement. The average consumption of oil by the dry-process plants was 0.2644 barrel (or 11.1 gallons) per barrel of finished cement, and by the wet-process plants 0.2869 barrel (12 gallons) per barrel of finished cement. The use of oil in 1927 was reported at 12 additional plants, which also used other fuel; 2 of these plants are east and 10 west of the Mississippi River.

Six plants reported natural gas as the only fuel used in 1928, as compared with 4 plants so reporting in 1927. The average consumption in 1928 was 2,133.7 cubic feet of gas per barrel of finished cement; the corresponding figure for 1927 is 2,450.5 cubic feet per barrel of finished cement. The use of natural gas was reported by 9 additional plants, which also used other fuel in 1928, and by 11 additional plants, which also used other fuel in 1927.

Portland cement burned, 1927–28, by kinds of fuel

Fuel	Finished cement produced			Fuel consumed		
	Number of plants	Barrels of 376 pounds	Per cent of total	Coal (short tons)	Oil (barrels of 42 gallons)	Natural gas (cubic feet)
1927						
Coal	123	[1] 139, 195, 851	80. 4	[2] 9, 451, 529	------	------
Oil	13	[1] 12, 686, 167	7. 3	------	3, 480, 426	------
Natural gas	4	[1] 3, 049, 663	1. 8	------	------	7, 473, 251. 400
Coal and oil	2	18, 274, 832	10. 5	539, 002	939, 456	16, 166, 999, 115
Coal and natural gas	1					
Oil and natural gas	6					
Coal, oil, and natural gas	4					
	153	173, 206, 513	100. 0	[3] 9, 990, 531	4, 419, 882	23, 640, 250, 515
1928						
Coal	124	[1] 140, 104, 670	79. 5	[2] 9, 186, 920	------	------
Oil	13	[1] 13, 078, 031	7. 4	------	[4] 3, 263, 537	------
Natural gas	6	[1] 4, 918, 561	2. 8	------	------	10, 494, 609, 200
Coal and oil	3	18, 197, 584	10. 3	615, 511	244, 501	20, 165, 739, 000
Coal and natural gas	2					
Oil and natural gas	3					
Coal, oil, and natural gas	4					
	155	176, 298, 846	100. 0	[5] 9, 802, 431	3, 508, 038	30, 660, 348, 200

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[1] Average consumption of fuel per barrel of cement produced was as follows: 1927—Coal, 135.8 pounds; oil, 0.2743 barrel; natural gas, 2,450.5 cubic feet. 1928—Coal, 131.1 pounds; oil, 0.2495 barrel; natural gas, 2,133.7 cubic feet.

[2] In addition to the coal shown for this group, 1 of the plants reports using some petroleum coke with coal.

[3] Includes 212,842 short tons of anthracite and 9,777,689 short tons of bituminous coal.

[4] In addition to the oil shown for this group, 1 of the plants reports using some petroleum coke with oil.

[5] Includes 210,390 short tons of anthracite and 9,592,041 short tons of bituminous coal.

The following table shows the total fuels used and the finished cement produced by the wet and dry processes in 1927 and 1928:

Portland cement burned and fuels used, 1927–28, by processes

Process	Finished cement produced			Fuel consumed		
	Number of plants [1]	Barrels	Per cent of total	Coal (short tons)	Oil (barrels)	Natural gas (cubic feet)
1927						
Wet [2]	77½	58,872,750	34.0	3,488,239	1,871,247	16,080,680,715
Dry	75½	114,333,763	66.0	[3] 6,502,292	2,548,635	7,559,569,800
	153	173,206,513	100.0	[4] 9,990,531	4,419,882	23,640,250,515
1928						
Wet	80½	67,209,923	38.1	3,805,151	1,586,078	20,837,560,400
Dry	74½	109,088,923	61.9	[3] 5,997,280	[5] 1,921,960	9,822,787,800
	155	176,298,846	100.0	[6] 9,802,431	3,508,038	30,660,348,200

[1] A wet mill and a dry mill in 1 plant are each counted as half a plant.
[2] Includes 1 semiwet plant.
[3] In addition to the coal shown for this group, 1 of the plants reports using some petroleum coke with coal.
[4] Includes 212,842 short tons of anthracite and 9,777,689 short tons of bituminous coal.
[5] In addition to the oil shown for this group, 1 of the plants reports using some petroleum coke with oil.
[6] Includes 210,390 short tons of anthracite and 9,592,041 short tons of bituminous coal.

Estimated clinker (unground cement) produced and in stock at mills in the United States, 1927–28, by processes, in barrels

Process	Number of plants [1]		Production		Stocks (Dec. 31)	
	1927	1928	1927	1928	1927	1928
Wet [2]	77½	80½	58,005,000	66,284,000	3,189,000	3,122,000
Dry	75½	74½	111,783,000	107,458,000	4,471,000	4,300,000
	153	155	169,788,000	173,742,000	7,660,000	7,422,000

[1] A wet mill and a dry mill in 1 plant are each counted as half a plant.
[2] In 1927 includes 1 semiwet plant.

CAPACITY

The capacity at the end of 1928 for production of finished Portland cement of the 156 plants active in 1928 and 3 plants inactive in 1928 but producing and shipping within the two previous years, according to manufacturers' reports supplemented by a few estimates, was 243,702,000 barrels per year. This total includes, besides the increased capacity due to extensions and improvements at old plants, approximately 3,900,000 barrels capacity for finished Portland cement of the 4 new plants completed during the year. The total production for 1928 was 72.3 per cent of the indicated capacity, based on producers' reports, at the close of the year; the corresponding figure for 1927 is 76.3 per cent.

Portland cement manufacturing capacity of the United States, 1927–28, by districts

District	Estimated capacity (barrels)		Per cent of capacity utilized	
	1927	1928	1927	1928
Eastern Pennsylvania, New Jersey, and Maryland	47,074,000	50,945,000	90.7	77.9
New York and Maine [1]	15,760,000	17,037,000	68.4	67.4
Ohio, western Pennsylvania, and West Virginia	23,260,000	24,671,000	74.5	74.3
Michigan	18,591,000	19,508,000	75.1	71.0
Wisconsin, Illinois, Indiana, and Kentucky	26,161,000	27,057,000	84.2	84.1
Virginia, Tennessee, Alabama, Georgia, Florida, and Louisiana	21,846,000	24,667,000	73.3	64.7
Eastern Missouri, Iowa, Minnesota, and South Dakota	20,357,000	22,993,000	70.5	72.6
Western Missouri, Nebraska, Kansas, and Oklahoma	14,013,000	14,598,000	72.0	74.9
Texas	7,230,000	7,700,000	78.2	82.4
Colorado, Montana, and Utah	5,592,000	5,567,000	39.0	49.8
California	21,813,000	22,700,000	66.8	59.7
Oregon and Washington	5,383,000	6,259,000	65.7	63.3
	227,080,000	243,702,000	76.3	72.3

[1] Maine began producing in April, 1928.

The following estimates of relation between the production of finished Portland cement and the manufacturing capacity of the industry for each month in 1928 and for the 12 months ending with each month, based on the monthly reports of the producers, indicate the seasonal changes in the utilization of capacity. These estimates include, besides the increases in production and capacity due to improvements at old plants, the production and capacity of the new plants put into operation during the period covered by the estimates. The new plants for 1928 are listed on pages 359 and 360.

Ratio (per cent) of finished Portland cement produced to manufacturing capacity, 1927–28

	Monthly		12 months ended—			Monthly		12 months ended—	
	1927	1928	1927	1928		1927	1928	1927	1928
January	45.1	49.4	76.4	74.5	July	90.4	87.0	73.9	73.7
February	44.6	47.5	76.2	75.1	August	94.5	93.1	74.0	73.5
March	61.9	51.7	76.0	74.6	September	92.6	91.7	72.3	73.7
April	78.1	70.0	76.3	74.0	October	87.4	87.1	73.6	73.8
May	88.9	86.6	75.5	73.9	November	75.9	77.4	73.7	74.1
June	93.1	90.1	74.3	73.8	December	60.7	60.4	76.2	74.0

The following table gives statistics of capacity by the two general methods—the "wet" and the "dry"—used in the manufacture of Portland cement at the plants in the United States. The figures given are based on the estimated capacity of the wet and dry process plants for the manufacture of finished cement. The figures show that the wet-process plants, representing 39 per cent of the total manufacturing capacity of the United States, in turning out 38.1 per cent of the finished cement produced in 1928, utilized 70.8 per cent of the wet-process capacity, and that the dry-process plants, accredited with 61 per cent of the total manufacturing capacity of the United States, in turning out 61.9 per cent of the finished cement produced in 1928, utilized 73.4 per cent of the dry-process capacity. Statistics of production of both clinker and finished cement, by processes, appear on page 362.

Portland cement manufacturing capacity of the United States in 1928, by processes

Process	Estimated capacity		Per cent of capacity utilized	Per cent of total finished cement produced
	Barrels	Per cent of total		
Wet	94,979,000	39.0	70.8	38.1
Dry	148,723,000	61.0	73.4	61.9
	243,702,000	100.0	72.3	100.0

SPECIAL CEMENTS

A number of types of cement are now being manufactured and marketed in the United States in addition to the standard or "ordinary" Portland cement. These have been developed in response to a demand for cement of certain pronounced qualities or characteristics, such as greater plasticity and high-early strength, quick-hardening, and waterproofing qualities for special needs or uses. As stated, such special cements as the white Portland cement and the plastic and waterproofed Portland cement have long been produced and marketed in the United States and have been included in the statistics in Mineral Resources. Alumina cement, a hydraulic cement noted especially for its attainment of high strength at early periods, has been manufactured in the United States for some years.

Among the natural cements that are noted for their plasticity and are much used in masonry, the producers now report "mixed" and "improved" cements.

According to the reports of the producers, 2,441,063 barrels of special cements of the Portland-cement class were manufactured in the United States in 1928, as compared with 3,119,233 barrels in 1927, and 2,364,938 barrels, valued at $4,881,024, were shipped from the mills in 1928, as compared with 2,784,860 barrels, valued at $5,269,741, in 1927. These figures do not include statistics of white Portland cement, as the Bureau of Mines is not at liberty to publish such figures separately. Companies reported the shipment of special cements of their own manufacture from 32 plants in 14 States in 1928, including 1 plant that shipped from stock but did not produce special cements during the year. The producers reported the manufacture of special cements at 27 plants in 12 States in 1927. The statistics are shown separately in the following table; they are included in the general statistics for Portland cement throughout this report.

Although a cement classified in one group may have qualities or characteristics by which another group is designated (for example, a high-early strength Portland cement which is also plastic), the grouping in the table follows the name or characteristic reported by the producer.

Special Portland cements reported produced and shipped in the United States, 1927–28, by types [1]

Type	Number of plants reporting		Production (barrels)		Shipments					
					1927		1928		Average factory value per barrel	
	1927	1928	1927	1928	Barrels	Value	Barrels	Value	1927	1928
High-early strength and quick-hardening Portland cement	10	10	1,615,884	1,374,329	1,344,815	$2,286,347	1,383,527	$2,488,190	$1.70	$1.80
Plastic and waterproofed Portland cement [2]	18	23	1,503,349	1,066,734	1,440,045	2,983,394	981,411	2,392,834	2.07	2.44

[1] Classified according to names or characteristics reported by the producers.

[2] Includes so-called "Oil-well," "Plastite," and "Super" Portland cements.

MASONRY, NATURAL, AND PUZZOLAN CEMENTS

The term "masonry cement" is used here to designate certain cements made, like natural cements, by grinding calcined calcareous rock and being used largely in mortar for laying brick and stone, although other hydraulic cements are also suitable for masonry.

Natural cement, including masonry cement, was produced in 1928 in 10 plants, situated as follows: Utica, Ill.; Speed, Ind.; Fort Scott, Kans.; Kosmosdale, Ky.; Austin and Mankato, Minn.; Brixment and Rosendale, N. Y.; Lisbon, Ohio; and Siegfried, Pa.

One manufacturer with a plant at Birmingham, Ala., reports an output of puzzolan or slag-lime cement, and in order that this output may be included in the cement totals for the United States without disclosure it is included with the statistics of masonry and natural cements.

The next table, which gives figures on the output of masonry, natural, and puzzolan cements in 1927 and 1928, shows that the production in 1928—2,210,404 barrels—exceeded that in 1927 by 4 per cent. Shipments of these cements from mills in 1928 increased nearly 3 per cent in quantity and 1 per cent in gross value as compared with 1927. Stocks at the mills were about 2 per cent lower at the end of 1928 than at the end of 1927. The average factory value per barrel of the cement shipped from the mills in 1928 was $1.31, as compared with $1.33 in 1927. The output has been expressed in terms of 376-pound barrels to correspond with the statistics for Portland cement.

The second table presents quoted wholesale prices of these cements in lots of 500 barrels or more, exclusive of bags, f. o. b. at a number of widely separated cities in the United States, as published by the Engineering News-Record; but in order to make a consistent comparison of these prices the reader should note that barrels of 240, 250, 260, 300, and 320 pounds are involved instead of the standard Portland-cement barrel of 376 pounds. These cements are packed four sacks to the barrel, each sack holding about 1 cubic foot, as with Portland cement, but the lower specific gravity of the non-Portland cements accounts for their lighter weight per barrel.

Producers reported that 46,629 short tons of coal were consumed in 1928 in the manufacture of these cements; in addition, they reported the use of small quantities of coke, oil, and gas having a total fuel value equivalent to approximately 645 short tons of coal. The fuel consumption in 1927 amounted to 47,553 short tons of coal; in addition, there were reported consumed small quantities of coke, oil, and gas having a total fuel value equivalent to approximately 440 short tons of coal.

At natural-cement plants in the United States where coal was reported as the only fuel used the average consumption in 1928 was 55 pounds of coal per barrel (376 pounds) of cement, as compared with an average consumption in 1927 of 54 pounds of coal per barrel (376 pounds) of cement.

Masonry, natural, and puzzolan cements produced, shipped, and in stock at mills in the United States, 1925–1928

Year	Production		Shipments		Stock (Dec. 31)
	Active plants	Barrels of 376 pounds	Barrels of 376 pounds	Value	Barrels of 376 pounds
1925	10	1,729,343	1,751,725	$2,551,583	107,459
1926	11	2,104,891	2,031,851	2,820,110	181,928
1927	11	2,123,868	2,158,323	2,881,029	[1] 143,854
1928	11	2,210,404	2,213,645	2,910,097	140,613

[1] Revised figures.

Wholesale prices of masonry, natural, and puzzolan cements, 1927–28, by months [1]

[Per barrel except as otherwise noted [2]]

City and brand	January		February		March		April	
	1927	1928	1927	1928	1927	1928	1927	1928
Birmingham (Magnolia)	$2.40	$2.40	$2.40	$2.40	$2.40	$2.40	$2.40	$2.60
Boston (Rosendale)	2.65	2.35	2.75	2.45	2.75	2.45	2.75	--------
Cincinnati (Utica)	1.72	1.72	1.72	1.72	1.72	1.72	1.72	1.72
Kansas City (Fort Scott)	1.40	1.45	1.45	1.45	1.45	1.35	1.45	1.80
Minneapolis (Rosendale)	2.80	2.80	2.80	2.80	2.80	2.80	2.80	--------
St. Louis (Carney)	2.35	2.60	2.35	2.60	2.35	2.65	2.35	2.10

City and brand	May		June		July		August	
	1927	1928	1927	1928	1927	1928	1927	1928
Birmingham (Magnolia)	$2.40	$2.60	$2.40	$2.60	$2.40	$2.60	$2.40	$2.60
Boston (Rosendale)	2.75	--------	2.75	--------	2.00	--------	2.00	--------
Cincinnati (Utica)	1.72	1.72	1.72	1.72	1.72	1.72	1.72	1.72
Kansas City (Fort Scott)	1.45	1.80	1.35	1.50	1.45	1.50	1.35	2.00
Minneapolis (Rosendale)	2.80	--------	2.80	--------	2.80	--------	2.80	--------
St. Louis (Carney)	2.75	1.92	2.75	1.92	2.75	2.25	2.85	2.25

City and brand	September		October		November		December	
	1927	1928	1927	1928	1927	1928	1927	1928
Birmingham (Magnolia)	$2.40	(3)	$2.40	(3)	$2.40	(3)	$2.40	(3)
Boston (Rosendale)	2.00	(3)	2.25	(3)	2.25	(3)	2.35	(3)
Cincinnati (Utica)	1.72	(3)	1.72	(3)	1.72	(3)	1.72	(3)
Kansas City (Fort Scott)	1.35	(3)	1.35	(3)	1.35	(3)	1.35	(3)
Minneapolis (Rosendale)	2.80	(3)	2.80	(3)	2.80	(3)	2.80	(3)
St. Louis (Carney)	2.85	(3)	2.85	(3)	2.85	(3)	2.60	(3)

[1] Engineering News-Record. Price to dealers per barrel for 500 barrels or more f. o. b., exclusive of bags.

[2] Available information indicates that the weights per barrel of these cements are as follows: Rosendale, 300 pounds; Utica, 240 and 265 pounds; Fort Scott, 240 pounds; Carney, 250 pounds; Magnolia (puzzolan cement), 320 pounds.

[3] Data not given for September to December, 1928.

IMPORTS AND EXPORTS [3]

IMPORTS

The quantities given in the following tables of imports include hydraulic cement of all kinds. Some of the cement imported evidently was not manufactured in the country from which it was shipped to the United States.

The imports of hydraulic cement into the United States in 1928—2,284,085 barrels—show an increase of 11.4 per cent over 1927, as compared with a decrease of 36.6 per cent in 1927 from 1926, which was one of the two annual decreases recorded in imports since 1921. In the imports, by countries, the increase was almost general. Imports from Norway, however, showed a decrease of nearly 71 per cent in 1928 from 1927. No imports were recorded from either Japan or the Netherlands, from which countries considerable quantities were reported received in 1927. The imports, by countries, were approximately as follows: From Belgium, 1,727,000 barrels (nearly 76 per cent of the total imports); Denmark, 339,000 barrels; United Kingdom, 96,000 barrels; Norway, 61,000 barrels; Canada, 38,000 barrels; and other countries, 23,000 barrels. The districts into which more than 300,000 barrels were imported in 1928 are, in order, Massachusetts, South Carolina, and Porto Rico. The total quantity imported into these three districts and into New York and North Carolina (fourth and fifth in order, respectively) was 70 per cent of the total imports into the United States in 1928. The average of the values assigned to the imports, which are supposed to represent the values in the foreign countries from which the material is exported, including the cost of the containers or coverings, was $1.35, a decrease of 9 cents per barrel compared with 1927.

The tariff act of 1922 put hydraulic cements on the free list, with the proviso that if any country imposes a duty on such cement coming from the United States an equal duty shall be imposed upon such cement coming into the United States from that country.

Roman, Portland, and other hydraulic cements imported into the United States, 1927–28, by countries

[General imports]

Country	1927		1928	
	Barrels	Value	Barrels	Value
Belgium	1,487,014	$2,083,524	1,726,557	$2,303,635
Canada	24,317	55,556	37,821	82,827
Chile	6	10		
Denmark	238,663	354,509	338,724	442,506
Dominican Republic	179	784		
France	6,438	12,960	10,276	26,028
Germany	7,623	10,442	9,276	21,612
Hungary			10	31
Irish Free State			3	34
Italy			5	14
Japan	17,500	34,292		
Netherlands	4,257	6,487		
Norway	209,178	294,049	61,327	73,655
Poland and Danzig			4,166	3,555
Soviet Russia in Europe	3	30		
Sweden			1	8
United Kingdom	55,002	103,808	95,919	136,955
	2,050,180	2,956,451	2,284,085	3,090,860

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[3] Figures on imports and exports compiled by J. A. Dorsey, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.

Roman, Portland, and other hydraulic cements imported into the United States, 1927–28, by districts

[General imports]

District	1927		1928	
	Barrels	Value	Barrels	Value
Alaska	5	$25		
Florida	308, 682	420, 286	72, 806	$91, 548
Galveston	18, 328	24, 908	105, 637	137, 691
Georgia	20, 000	30, 080		
Hawaii	37, 326	61, 356	37, 444	47, 438
Los Angeles	11, 278	18, 770	15, 188	28, 780
Maine and New Hampshire	42, 602	72, 179	50, 335	98, 862
Maryland	500	809	4, 166	3, 555
Massachusetts	481, 541	649, 686	470, 340	660, 914
New Orleans	55, 031	80, 925	15, 584	20, 246
New York	39, 423	67, 317	222, 833	302, 259
North Carolina			177, 160	238, 586
Ohio			2	12
Oregon	31, 620	43, 269	70, 728	87, 583
Philadelphia	305, 920	425, 485	167, 522	237, 523
Porto Rico	319, 653	511, 399	324, 286	432, 954
Rhode Island	80, 156	108, 627	54, 036	71, 016
Sabine	8, 000	15, 500	6, 420	13, 564
St. Lawrence	16, 242	38, 632	1, 510	2, 894
San Antonio			15, 000	17, 700
San Francisco	38, 007	50, 431	380	725
South Carolina	196, 571	279, 801	413, 055	516, 084
Vermont	1, 518	2, 293	974	1, 378
Virginia	5, 974	9, 666	1, 200	1, 328
Washington	31, 803	45, 007	57, 479	78, 220
	2, 050, 180	2, 956, 451	2, 284, 085	3, 090, 860

Roman, Portland, and other hydraulic cements imported into the United States in 1928, by countries and districts

[General imports]

Country and district	Barrels	Value
Belgium:		
Florida	72, 806	$91, 548
Galveston	93, 637	121, 906
Hawaii	37, 444	47, 438
Los Angeles	6, 100	7, 326
Maine and New Hampshire	15, 000	20, 313
Massachusetts	470, 090	660, 497
New Orleans	15, 584	20, 246
New York	114, 581	147, 369
North Carolina	177, 160	238, 586
Ohio	1	4
Oregon	67, 567	84, 044
Philadelphia	138, 692	200, 366
Porto Rico	705	1, 260
Rhode Island	54, 036	71, 016
Sabine	6, 420	13, 564
San Antonio	15, 000	17, 700
South Carolina	383, 055	480, 904
Virginia	1, 200	1, 328
Washington	57, 479	78, 220
	1, 726, 557	2, 303, 635
Canada:		
Maine and New Hampshire	35, 335	78, 549
St. Lawrence	1, 510	2, 894
San Francisco	2	6
Vermont	974	1, 378
	37, 821	82, 827
Denmark:		
New York	36, 326	38, 000
Oregon	3, 000	3, 205
Porto Rico	299, 398	401, 301
	338, 724	442, 506
France:		
Los Angeles	2	$15
New York	10, 261	25, 983
Oregon	13	30
	10, 276	26, 028
Germany:		
Los Angeles	8, 786	20, 814
Massachusetts	250	417
New York	234	342
Philadelphia	6	39
	9, 276	21, 612
Hungary: Philadelphia	10	31
Irish Free State: New York	3	34
Italy: New York	5	14
Norway:		
Philadelphia	7, 069	8, 006
Porto Rico	24, 183	30, 393
San Francisco	75	76
South Carolina	30, 000	35, 180
	61, 327	73, 655
Poland and Danzig: Maryland	4, 166	3, 555
Sweden: New York	1	8
United Kingdom:		
Galveston	12, 000	15, 785
Los Angeles	300	625
New York	61, 422	90, 509
Ohio	1	8
Oregon	148	304
Philadelphia	21, 745	29, 081
San Francisco	303	643
	95, 919	136, 955
	2, 284, 085	3, 090, 860

In addition to the imports shown in the preceding tables, "white nonstaining Portland cement" was recorded as "imported for consumption," as follows: 1927, 15,800 barrels, valued at $50,657; 1928, 16,308 barrels, valued at $44,445. The source of these imports, by countries, is not recorded; the figures are included in those shown in the following table:

Hydraulic cement imported for consumption in the United States, 1919–1928

Year	Barrels [1]	Value	Year	Barrels [1]	Value
1919	8, 931	$52, 636	1924	2, 023, 663	$3, 139, 788
1920	524, 604	1, 254, 729	1925	3, 667, 458	5, 836, 482
1921	122, 317	388, 842	1926	3, 244, 223	5, 154, 926
1922	355, 931	692, 429	1927	2, 065, 730	3, 007, 103
1923	1, 767, 264	3, 145, 977	1928	2, 302, 475	3, 135, 558

[1] Barrels of 380 pounds in 1919 and 376 pounds in later years.

EXPORTS

In 1928 the hydraulic cement exported to foreign countries and to the Philippine Islands and the Virgin Islands of the United States, most of it Portland cement, increased 1 per cent in quantity and 5 per cent in value as compared with 1927. The quantity exported in 1928 was 0.5 per cent of the total shipments of hydraulic cement from mills during the year. The average value at the ports of export was $3.56 a barrel, as compared with $3.42 in 1927.

The destinations of exports were approximately as follows: To South America, 343,000 barrels; Central America, 126,000 barrels; Cuba, 100,000 barrels; other West Indies and Bermuda, 57,000 barrels; Mexico, 78,000 barrels; Canada, 40,000 barrels; and other countries, 81,000 barrels. The export trade varies from year to year, but has never reached large proportions; it has not reached 2,000,000 barrels since 1920. During recent years strong competition from manufacturers in Europe, where labor costs are much lower than in the United States, has restricted the foreign market for American cement.

Hydraulic cement exported from the United States, 1927–28, by countries

Country	1927		1928	
	Barrels	Value	Barrels	Value
North America:				
Canada	24, 103	$112, 741	39, 927	$202, 628
Central America—				
British Honduras	31	146	54	181
Costa Rica	1, 945	7, 140	2, 308	7, 561
Guatemala	5, 666	17, 261	4, 168	15, 215
Honduras	16, 487	42, 973	14, 404	36, 028
Nicaragua	1, 795	5, 248	3, 309	9, 803
Panama	92, 245	275, 287	100, 955	298, 270
Salvador	2, 010	8, 856	520	3, 161
Mexico	78, 516	254, 214	77, 676	250, 371
Miquelon, Langley, and St. Pierre Islands	100	580		
Newfoundland and Labrador	123	611	40	192
West Indies—				
British—				
Barbados	12	77	20	132
Bermuda	5, 326	14, 753	1, 887	4, 268
Jamaica	159	1, 128	22	153
Trinidad and Tobago	210	1, 458		
Other British	11, 363	26, 471	10, 772	27, 605

Hydraulic cement exported from the United States, 1927–28, by countries—Continued

Country	1927		1928	
	Barrels	Value	Barrels	Value
North America—Continued.				
West Indies—Continued.				
Cuba	107, 020	$279, 957	99, 907	$256, 201
Dominican Republic	3, 513	13, 620	4, 277	17, 741
Netherland	3, 321	12, 469	18, 657	48, 960
French	10	29	--------	--------
Haiti	44, 639	91, 970	21, 446	46, 186
Virgin Islands of the United States	84	250	301	714
South America:				
Argentina	49, 279	290, 879	67, 899	393, 846
Bolivia	--------	--------	4, 619	12, 570
Brazil	15, 222	89, 243	24, 011	143, 105
Chile	15, 723	48, 037	4, 847	24, 934
Colombia	56, 920	169, 686	69, 194	176, 616
Ecuador	3, 793	12, 776	2, 466	7, 452
Guiana—				
British	--------	--------	5	36
French	330	841	165	421
Surinam	500	1, 575	--------	--------
Peru	14, 030	40, 406	8, 376	29, 481
Uruguay	77, 852	226, 129	79, 051	226, 301
Venezuela	119, 243	370, 686	81, 913	225, 370
Europe:				
Azores and Madeira Islands	2, 460	5, 651	165	485
Belgium	6	35	16	106
Denmark	231	1, 730	161	1, 440
Finland	--------	--------	10	65
Germany	2, 134	12, 218	3, 131	17, 780
Greece	195	1, 164	170	1, 003
Hungary	--------	--------	500	2, 888
Irish Free State	150	873	370	2, 070
Italy	4	24	150	887
Netherlands	119	777	432	2, 627
Norway	400	2, 501	370	2, 320
Portugal	110	847	20	127
Rumania	107	1, 000	35	216
Spain	1, 725	10, 192	495	2, 913
Sweden	48	301	56	427
United Kingdom	36, 068	214, 535	45, 787	265, 032
Asia:				
China	1, 432	8, 444	1, 482	8, 776
East Indies—				
British—				
Ceylon	10	66	120	774
India	2, 800	16, 411	4, 420	27, 045
Malaya	3, 570	21, 096	5, 840	33, 735
Netherland—				
Java and Madura	910	5, 089	1, 224	5, 041
Other	--------	--------	242	2, 270
Hong Kong	50	300	795	4, 704
Iraq	90	540	250	1, 535
Japan	983	6, 175	1, 271	9, 620
Palestine	375	2, 214	755	4, 430
Persia	--------	--------	1	15
Philippine Islands	1, 164	7, 080	926	9, 456
Siam	50	318	25	162
Africa:				
British—				
East	270	1, 643	120	720
Union of South	268	1, 689	631	3, 897
West	--------	--------	1	6
Egypt	125	723	313	1, 747
French—Other	250	637	--------	--------
Liberia	104	495	--------	--------
Portuguese—				
Mozambique	170	1, 086	125	725
Other Portuguese	38	203	70	236
Oceania:				
British—				
Australia	5, 161	30, 400	7, 781	40, 290
New Zealand	3, 551	22, 603	2, 775	16, 494
Other British	8	100	265	750
French	20	60	160	386
	816, 726	2, 796, 717	824, 656	2, 938, 702

Domestic hydraulic cement shipped to Alaska, Hawaii, and Porto Rico, 1927–28

	1927		1928	
	Barrels	Value	Barrels	Value
Alaska	19,517	$59,815	13,838	$41,430
Hawaii	296,639	710,730	291,305	681,468
Porto Rico	103,741	256,179	46,700	114,409
	419,897	1,026,724	351,843	837,307

Hydraulic cement exported from the United States, 1919–1928

Year	Barrels	Value	Per cent of total shipments from mills	Year	Barrels	Value	Per cent of total shipments from mills
1919	2,463,573	$7,513,389	2.9	1924	878,543	$2,615,154	0.6
1920	2,985,807	10,045,369	3.1	1925	1,019,597	3,003,128	.6
1921	1,181,014	4,276,986	1.2	1926	974,326	2,995,833	.6
1922	1,127,845	3,206,201	1.0	1927	816,726	2,796,717	.5
1923	1,001,688	2,944,174	.7	1928	824,656	2,938,702	.5

CEMENT PRODUCTION IN CANADA

The total mill output of Portland cement in Canada in 1928 was 11,076,659 barrels, according to the Dominion Bureau of Statistics. The shipments amounted to 11,023,928 barrels, valued at $16,739,163, compared with 10,065,865 barrels, valued at $14,391,937. in 1927, an increase of 9.5 per cent in quantity and of 16.3 per cent in value. The average selling price over the whole Dominion, computed from the total quantity sold and the total value as given, was $1.52 a barrel in 1928 and $1.43 a barrel in 1927.

The apparent consumption of cement in Canada in 1928 increased 9 per cent over that in 1927. Imports in 1928 amounted to 34,047 barrels, having an average value of $4.29 a barrel, as compared with an average of $4.52 a barrel in 1927. Exports of Portland cement amounted to 267,325 barrels, with an invoiced value of $340,624.

Summary statistics of the cement industry in Canada, 1927–28 [1]

	1927		1928	
	Barrels	Value	Barrels	Value
Output	9,927,163		11,076,659	
Sold or used	10,065,865	$14,391,937	[2] 10,954,184	[2] $16,583,703
Stocks, Dec. 31	1,470,611		1,590,326	
Imports:				
Portland	19,354	87,541	34,047	146,164
Manufactures		17,879		31,594
Exports	249,694	308,144	267,325	340,624
Apparent consumption	9,835,525		10,720,906	

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[1] Dominion Bureau of Statistics.

[2] Figures relating to sales revised in later reports to 11,023,928 barrels, valued at $16,739,163.

Cement is produced in Quebec, Ontario, Manitoba, Alberta, and British Columbia. Eleven plants were represented in the output in 1928, as compared with 12 in the previous year. Quebec mills led in shipments in 1928, accounting for about 45 per cent of the total quantity reported as sold, and Ontario followed, with nearly 36 per cent.

The average selling price a barrel f. o. b. plant, by Provinces, in 1928 was as follows: Quebec, $1.28; Ontario, $1.41; Manitoba, $2.43; Alberta, $2.08; and British Columbia, $2.23.

The following table shows sales from mills in 1927 and 1928, by Provinces:

Cement sold by Canadian mills, 1927–28, by Provinces [1]

Province	1927		1928	
	Barrels	Value	Barrels	Value
Quebec	4, 636, 751	$5, 383, 058	4, 913, 820	$6, 305, 396
Ontario	3, 751, 786	5, 144, 326	3, 911, 795	5, 520, 897
Manitoba	551, 698	1, 378, 121	693, 450	1, 685, 084
Alberta	601, 699	1, 303, 880	834, 067	1, 732, 582
British Columbia	523, 931	1, 182, 552	670, 796	1, 495, 204
Canada	10, 065, 865	14, 391, 937	11, 023, 928	16, 739, 163

[1] Dominion Bureau of Statistics.

NATURAL GAS[1]

By G. R. Hopkins and H. Backus

SUMMARY

The steady growth of the natural-gas industry was continued in 1928, when the consumption reached the new peak of 1,567,979,000,000 cubic feet, valued at $363,631,000. These figures represent increases over 1927 of 8 per cent in quantity and 14 per cent in value. It is worthy of note that the percentage increase in quantity of gas is very close to the increase in number of gas wells completed—2,727 wells in 1928 compared with 2,491 in 1927, an increase of 9 per cent. A material expansion in pipe-line facilities was reflected in an increase in the number of domestic consumers—from 3,984,000 in 1927 to 4,344,000 in 1928. The average price paid for natural gas by domestic (household) consumers increased for the twentieth successive year and amounted in 1928 to 62 cents per thousand cubic feet. The total quantity of natural gas used for industrial purposes increased, but the quantity consumed by refineries decreased as a result of the displacement of natural gas in some localities by low-priced fuel oil. Although the use of natural gas for field purposes constituted the largest single item among the industrial uses listed, the consumption of natural gas by carbon-black manufacturers made much the largest actual gain in 1928. After declining in 1927, the interstate movement of natural gas in 1928 rose to the new high level of 241,386,000,000 cubic feet. This increase was an aftermath of the expansion program of the industry in 1928, as typified by the growth in trunk-line mileage between States.

Summary of statistics for natural gas in the United States, 1924–1928

	1924	1925	1926	1927	1928
Natural gas consumed:					
Domestic .... millions of cubic feet..	285, 152	272, 146	289, 175	296, 036	320, 877
Industrial [a]—					
Carbon black .... do....	156, 514	140, 366	130, 321	144, 087	175, 137
Field .... do....	393, 437	423, 524	478, 188	549, 455	573, 698
Electric public-utility power plant fuel .... millions of cubic feet..	48, 443	46, 521	53, 207	62, 919	77, 326
Refinery fuel .... do....	257, 936	87, 842	121, 449	123, 395	114, 950
Other industrial .... do....		218, 040	240, 513	269, 352	305, 991
	1, 141, 482	1, 188, 439	1, 312, 853	1, 445, 244	1, 567, 979
Domestic .... per cent..	25	23	22	20	20
Industrial .... do....	75	77	78	80	80
Treated for natural gasoline:					
Millions of cubic feet	1, 016, 276	1, 040, 390	1, 206, 300	1, 341, 248	1, 473, 434
Per cent of total consumption	89	88	92	93	94

[a] Figures on consumption by public utilities from U. S. Geological Survey; others partly estimated.

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[1] Work on manuscript completed November, 1929.

Summary of statistics for natural gas in the United States, 1924–1928—Contd.

	1924	1925	1926	1927	1928
Domestic consumers............thousands..	3,443	3,508	3,731	3,984	4,344
Value of natural gas at wells:					
Total............thousands of dollars..	105,779	112,047	124,693	127,468	139,898
Average per M cubic feet............cents..	9.3	9.4	9.5	8.8	8.9
Value of natural gas at points of consumption:					
Total............thousands of dollars..	253,830	265,184	300,055	317,803	363,631
Domestic............do....	154,075	152,494	168,870	180,018	198,808
Industrial............do....	99,755	112,690	131,185	137,785	164,823
Average per M cubic feet—					
Domestic............cents..	54.0	56.0	58.4	60.8	62.0
Industrial............do....	11.6	12.3	12.8	12.0	13.2
Domestic and industrial............do....	22.2	22.3	22.9	22.0	23.2
Natural gasoline:					
Quantity............thousands of gallons..	933,861	1,127,470	1,363,090	1,641,144	1,814,034
Value at plants—					
Total............thousands of dollars..	82,233	120,383	136,412	118,688	138,944
Average per gallon............cents..	8.8	10.7	10.0	7.2	7.7
Carbon black:					
Quantity............thousands of pounds..	186,872	177,417	180,576	198,429	248,790
Value at plants—					
Total............thousands of dollars..	11,565	9,640	9,939	10,955	13,782
Average per pound............cents..	6.2	5.4	5.5	5.5	5.5

PRODUCTION AND CONSUMPTION

The total production of natural gas in the United States during 1928 amounted to 1,568,139,000,000 cubic feet, an increase over 1927 of 122,711,000,000 cubic feet or 8 per cent. This total does not include the large quantities of natural gas blown into the air incident to the production of oil in flush fields. Deliveries of natural gas to Canada and Mexico declined from 184,000,000 cubic feet in 1927 to 160,000,000 cubic feet in 1928; deducting the 160,000,000 cubic feet piped out of the country from the total production gives 1,567,979,000,000 cubic feet as the total consumption in the United States during 1928.

No material change occurred in 1928 in the rank of the larger natural-gas producing States. Production in Oklahoma fell off, but the State continued to hold first place ahead of Texas, where a material increase in output was recorded. Production in Louisiana increased 22 per cent in 1928; the increase placed the State within striking distance of California, which held third place. The largest relative decline occurred in Arkansas, where production fell off one-third compared with 1927 and was less than half the 1926 total. In the production of natural gas five States are preeminent, namely, Oklahoma, Texas, California, Louisiana, and West Virginia, and in 1928 these States accounted for 80 per cent of the total output for the country. Although this might indicate a centralization of the natural-gas industry in a few localities, the localization is not as pronounced as in the crude-petroleum industry, where three States—Texas, Oklahoma, and California—accounted for 82 per cent of the total output in 1928.

The total estimated value at wells of the natural gas produced in 1928 amounted to $139,898,000, an average of 8.9 cents per thousand cubic feet. This average compares with 8.8 cents in 1927 and 9.5 cents in 1926. The average prices charged for natural gas at the wells in 1928 ranged from 2 cents per thousand cubic feet in Utah to as high as 34.7 cents in Indiana.

The total value at points of consumption of the natural gas consumed (including gas piped to Canada and Mexico) in 1928 amounted to $363,726,000, an increase over 1927 of $45,796,000 or 14 per cent. The average value per thousand cubic feet at points of consumption was 23.2 cents in 1928, compared with 22 cents in 1927, an increase of 1.2 cents, or the same increase as in the price of gas for domestic (household) use. Although West Virginia ranked only fifth in production it was the leading State in total value at points of consumption, due to the fact that the major portion of the gas produced in the State is destined for domestic (household) consumption at a relatively high price, whereas the major portion of the gas produced in Oklahoma, for example, is used for field purposes at close to "at-the-well" prices.

Natural gas produced in the United States and delivered to consumers, 1906–1928, by States, in millions of cubic feet

Year	Arkansas	California	Illinois	Indiana	Kansas	Kentucky	Louisiana	Montana	New York	Ohio	Oklahoma	Pennsylvania	Texas	West Virginia	Wyoming	Others	Total	Value at points of consumption	
																		Total (thousands of dollars)	Average per M cubic feet (cents)
1906	(1)	153	410	7,861	69,323	789	[2] 1,039	-------	2,548	45,436	3,520	138,161	(2)	119,400	(1)	203	388,843	46,874	12.1
1907	(1)	230	1,155	6,624	76,707	1,303	[2] 1,288	-------	3,288	52,041	4,867	135,516	(2)	122,687	(1)	916	406,622	54,222	13.3
1908	(1)	479	4,979	5,256	80,740	1,430	[2] 1,752	-------	3,843	47,442	11,925	130,476	(2)	112,181	(1)	1,638	402,141	54,640	13.6
1909	(1)	2,324	8,473	6,159	75,074	2,097	[2] 4,365	-------	4,696	53,223	28,037	127,697	(2)	166,435	(1)	2,126	480,706	63,207	13.1
1910	(1)	2,764	6,723	5,760	59,380	1,357	[2] 8.110	-------	6,010	48,232	50,430	126,867	(2)	190,706	(1)	2,816	509,155	70,756	13.9
1911	(1)	6,390	6,762	4,365	38,800	1,275	[3] 9,786	-------	5,240	49,450	67,276	108,869	5,503	206,891	(1)	2,386	512,993	74,622	14.5
1912	(1)	9,355	5,603	3,618	28,068	1,951	[3] 14,493	-------	8,626	56,210	73,799	112,150	7.470	239,007	(1)	1,853	562,203	84,564	15.0
1913	(1)	11,035	4,767	2,921	22,884	1,821	[3] 26,653	-------	8,515	50,612	75,018	118,860	12,160	245,454	(1)	1,198	581,898	87,847	15.1
1914	(1)	17,829	3,548	2,580	22,628	1,422	[3] 26,775	-------	8,935	68,270	78,167	110,745	13,434	236,489	(1)	1,045	591,867	94,116	15.9
1915	[4] 992	21,891	2,690	2,261	27,046	1,667	25,540	6	7,977	79,510	87,517	113,692	13,324	244,004	(1)	462	628,579	101,312	16.1
1916	2,388	31,643	3,534	1,715	31,710	2,107	32,081	213	8,036	69,888	123,517	130,484	15,810	299,319	(1)	725	753,170	120,227	16.0
1917	5,610	49,427	4,439	1,712	24,439	2,802	31,287	334	8,372	68,917	137,384	133,397	17,047	308,617	(1)	1,326	795,110	142,089	17.9
1918	5,295	39,719	4,473	1,667	27,825	3,022	36,094	177	8,461	61,261	124,317	123.813	13,440	265,161	4,339	1,937	721,001	153,554	21.3
1919	5,587	55,607	3,825	1,407	16,150	2,057	47,062	858	8,124	63,153	163,649	113,489	24,710	234,095	6,014	129	745,916	160,888	21.6
1920	9,027	66,041	3,013	1,779	21,158	3,345	58,274	818	8,419	58,938	154,467	125,787	37.063	239,719	10,312	50	798,210	196,194	24.6
1921	4,260	75,942	2,646	1,066	15,717	4,820	58,004	336	6,583	47,412	124,058	86.144	44,504	174,921	15,608	31	662,052	174,617	26.4
1922	9,700	84,580	3,383	947	20,289	5,872	70,267	486	6,947	51,481	140,631	101,276	47,945	195,288	23,427	27	762.546	221,535	29.1
1923	24,215	131,434	4,049	880	30,913	11,953	112,031	1,470	6,497	53,812	203,082	112,562	74,535	203,867	35,523	153	1,006,976	240,001	23.8
1924	36,616	189,692	4,072	998	25,580	12,875	160,945	1,071	6,196	47,396	214,452	105,863	107,247	182,285	46.036	197	1,141,521	253,856	22.2
1925	41,878	187,789	4,165	1,168	26,917	10,770	152,620	1,496	6,210	43,235	249,285	101,632	134,872	180,345	45,539	650	1,188,571	265,271	22.3
1926	43,566	204,915	3,808	901	38,095	10,410	157,423	2,283	7,027	47,363	286,421	107,089	175,392	180,223	46,567	1,536	1,313,019	300,168	22.9
1927	30,450	212,364	3,741	1,124	42,646	10,206	186,961	4,253	5,908	51,381	326,864	105,709	254,063	162,375	43,582	3,801	1,445,428	317,930	22.0
1928	20,235	246,215	3,051	1,290	45,644	15,383	227,821	6,277	7,224	56,341	320,861	99,466	301,990	163,018	47,490	5,833	1,568,139	363,726	23.2

[1] Included under "Others."
[2] Alabama and Texas included with Louisiana.
[3] Includes Alabama.
[4] Includes gas piped from Oklahoma and consumed in Arkansas.

Statistics of natural gas in the United States, 1906–1928

Year	Produced and delivered to consumers (billions of cubic feet)	Treated for recovery of natural gasoline		Domestic consumption					Industrial consumption[1]							
		Billions of cubic feet	Per cent of total consumption	Number of consumers (thousands)	Billions of cubic feet	Average number of M cubic feet used per consumer	Per cent of total consumption	Average value at points of consumption per M cubic feet (cents)	Field (billions of cubic feet)	Carbon black (billions of cubic feet)	Refineries (billions of cubic feet)	Electric public-utility power plants (billions of cubic feet)	Other industrial (billions of cubic feet)	Total industrial (billions of cubic feet)	Per cent of total consumption	Average value at points of consumption per M cubic feet (cents)
1906	339	(2)	(2)	875	110	126.2	28	22.7	(2)	(2)	(2)	(2)	(2)	279	72	7.8
1907	407	(2)	(2)	1,058	132	124.2	32	23.7	(2)	(2)	(2)	(2)	(2)	275	68	8.4
1908	402	(2)	(2)	1,166	141	120.6	35	23.6	(2)	(2)	(2)	(2)	(2)	261	65	8.2
1909	481	(2)	(2)	1,223	151	123.6	31	24.2	(2)	(2)	(2)	(2)	(2)	330	69	8.1
1910	509	(2)	(2)	1,328	170	127.9	33	24.4	(2)	(2)	(2)	(2)	(2)	339	67	8.6
1911	513	2		1,498	175	117.1	34	25.3	(2)	(2)	(2)	(2)	(2)	338	66	9.0
1912	562	5	1	1,623	193	119.2	34	26.3	(2)	(2)	(2)	(2)	(2)	369	66	9.1
1913	582	10	2	1,911	185	96.8	32	27.3	(2)	(2)	(2)	(2)	(2)	397	68	9.4
1914	592	17	3	2,078	203	97.8	34	28.0	(2)	(2)	(2)	(2)	(2)	389	66	9.6
1915	629	24	4	2,195	217	98.9	35	28.3	(2)	(2)	(2)	(2)	(2)	412	65	9.7
1916	753	209	28	2,362	235	99.6	31	28.6	(2)	(2)	(2)	(2)	(2)	518	69	10.2
1917	795	429	54	2,431	258	106.2	32	30.8	(2)	(2)	(2)	(2)	(2)	537	68	11.7
1918	721	449	62	2,509	271	108.1	38	31.4	(2)	(2)	(2)	(2)	(2)	450	62	15.2
1919	746	480	64	2,501	256	102.2	34	34.6	170	50	(3)	21	[3] 249	490	66	14.8
1920	798	496	62	2,615	286	109.4	36	38.2	202	41	(3)	25	[3] 244	512	64	17.0
1921	662	465	70	2,631	248	94.4	38	44.4	182	51	(3)	24	[3] 157	414	62	15.5
1922	763	545	71	3,015	255	84.4	33	49.9	198	54	(3)	27	[3] 229	508	67	18.6
1923	1,007	876	87	3,234	277	85.7	28	51.4	343	109	(3)	31	[3] 247	730	72	13.4
1924	[4] 1,142	1,016	89	3,443	285	82.8	25	54.0	393	157	(3)	48	[3] 258	856	75	11.6
1925	[4] 1,189	1,040	88	3,508	272	77.6	23	56.0	424	140	88	46	218	916	77	12.3
1926	[4] 1,313	1,206	92	3,731	289	77.5	22	58.4	478	131	122	53	240	1,024	78	12.8
1927	[4] 1,445	1,341	93	3,984	296	74.3	20	60.8	549	144	123	63	270	1,149	80	12.0
1928	[4] 1,568	1,473	94	4,344	321	73.9	20	62.0	574	175	115	77	306	1,247	80	13.2

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[1] Figures on consumption by public utilities from U. S. Geological Survey; others partly estimated.
[2] Figures not available.
[3] Refinery fuel included under "Other industrial"; separate figures not available.
[4] Includes gas piped to Canada and Mexico.

Natural gas produced and consumed in the United States, 1927–28, by States

State	Produced and delivered to consumers, including deliveries in other States						Consumed, including receipts from other States			
	Quantity		Estimated value at the wells		Value at points of consumption		Quantity		Value at points of consumption	
	M cubic feet	Per cent of total	Total	Average per M cubic feet (cents)	Total	Average per M cubic feet (cents)	M cubic feet	Per cent of total	Total	Average per M cubic feet (cents)
1927										
Ark	30,450,000	2.1	$1,486,000	4.9	$4,281,000	14.1	40,916,000	2.8	$5,751,000	14.1
Calif	212,364,000	14.7	19,431,000	9.1	50,946,000	24.0	212,364,000	14.7	50,946,000	24.0
Colo	1,725,400	.1	173,000	10.0	290,000	16.8	1,544,000	.1	277,000	17.9
Ill	3,741,000	.3	678,000	18.1	764,000	20.4	3,741,000	.3	764,000	20.4
Ind	1,124,000	.1	406,000	36.1	509,000	45.3	2,166,000	.1	1,076,000	49.7
Kans	42,646,000	3.0	3,263,000	7.7	12,833,000	30.1	66,618,000	4.6	13,998,000	21.0
Ky	10,206,000	.7	946,000	9.3	3,277,000	32.1	16,694,000	1.2	5,608,000	33.6
La	186,961,000	12.9	5,609,000	3.0	12,158,000	6.5	170,310,000	11.8	9,340,000	5.5
Mich	600	(1)	50	8.3	300	50.0	600	(1)	300	50.0
Mo	300	(1)	30	10.0	200	66.7	6,584,300	.5	5,265,000	80.0
Mont	4,253,100	.3	131,800	3.1	716,400	16.8	5,455,000	.4	918,000	16.8
N. Mex	1,019,000	.1	45,000	4.4	48,500	4.8	1,019,000	.1	48,500	4.8
N. Y	[2]5,908,000	.4	1,731,000	29.3	3,841,000	65.0	16,174,500	1.1	10,514,000	65.0
N. Dak	200	(1)	20	10.0	100	50.0	2,300	(1)	1,300	56.5
Ohio	51,381,000	3.5	8,632,000	16.8	28,881,000	56.2	112,603,000	7.8	64,258,000	57.1
Okla	326,864,000	22.6	21,508,000	6.6	41,391,000	12.7	286,485,000	19.8	33,503,000	11.7
Pa	105,709,500	7.3	26,502,000	25.1	49,135,000	46.5	121,982,000	8.4	54,473,000	44.7
S. Dak	92,000	(1)	8,130	8.8	136,500	148.4	92,000	(1)	136,500	148.4
Tenn	9,000	(1)	800	8.9	2,200	24.4	9,000	(1)	2,200	24.4
Tex	[3]254,063,000	17.6	11,204,000	4.4	37,424,800	14.7	269,944,000	18.7	40,141,000	14.9
W. Va	162,375,000	11.2	23,918,000	14.7	67,994,000	41.9	66,200,000	4.6	17,082,000	25.8
Wyo	43,581,600	3.0	1,765,000	4.0	3,269,800	7.5	42,559,000	2.9	3,080,000	7.2
Other[4]	954,300	.1	30,170	3.2	31,200	3.3	1,781,300	.1	620,200	34.8
	1,445,428,000	100.0	127,468,000	8.8	317,930,000	22.0	1,445,244,000	100.0	317,803,000	22.0
1928										
Ark	20,235,000	1.3	1,295,000	6.4	3,562,000	17.6	37,763,000	2.4	6,647,000	17.6
Calif	246,215,000	15.7	21,692,000	8.8	56,695,000	23.0	246,215,000	15.7	56,695,000	23.0
Colo	2,931,000	.2	293,000	10.0	786,000	26.8	6,347,000	.4	1,847,000	29.1
Ill	3,051,000	.2	305,000	10.0	360,000	11.8	3,051,000	.2	360,000	11.8
Ind	1,290,000	.1	448,000	34.7	639,000	49.5	2,259,000	.2	1,201,000	53.2
Kans	45,644,000	2.9	3,063,000	6.7	14,144,000	31.0	72,671,000	4.6	17,011,000	23.4
Ky	15,383,000	1.0	1,677,000	10.9	5,349,000	34.8	15,802,000	1.0	6,468,000	40.9
La	227,821,000	14.5	7,518,000	3.3	20,279,000	8.9	188,755,000	12.0	13,136,000	7.0
Mich	469,000	(1)	40,000	8.5	149,000	31.8	469,000	(1)	149,000	31.8
Mo	360,000	(1)	31,000	8.6	217,000	60.3	9,766,000	.6	5,902,000	60.4
Mont	6,277,000	.4	274,000	4.4	1,446,000	23.0	7,265,000	.5	1,524,000	21.0
N. Mex	838,000	(1)	43,000	5.1	66,000	7.9	854,000	.1	67,000	7.8
N. Y	[5]7,224,000	.5	2,332,000	32.3	4,827,000	66.8	17,918,000	1.1	11,975,000	66.8
Ohio	56,341,000	3.6	10,125,000	18.0	32,090,000	57.0	122,484,000	7.8	70,295,000	57.4
Okla	320,861,000	20.5	20,984,000	6.5	47,476,000	14.8	285,333,000	18.2	38,845,000	13.6
Pa	99,466,000	6.3	29,114,000	29.3	48,432,000	48.7	116,150,000	7.4	54,388,000	46.8
S. Dak	54,000	(1)	5,000	9.3	53,000	98.1	214,000	(1)	212,000	99.1
Tex	[6]301,990,000	19.3	10,328,000	3.4	51,316,000	17.0	318,718,000	20.3	54,270,000	17.0
Utah	1,105,000	.1	22,000	2.0	22,000	2.0	1,105,000	.1	22,000	2.0
W. Va	163,018,000	10.4	28,659,000	17.6	72,265,000	44.3	67,272,000	4.3	18,631,000	27.7
Wyo	47,490,000	3.0	1,643,000	3.5	3,527,000	7.4	46,549,000	3.0	3,290,000	7.1
Other[4]	76,000	(1)	7,000	9.2	26,000	34.2	1,019,000	.1	696,000	68.3
	1,568,139,000	100.0	139,898,000	8.9	363,726,000	23.2	1,567,979,000	100.0	363,631,000	23.2

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[1] Less than 0.1 per cent.

[2] Includes 71,000 M cubic feet consumed in Canada.

[3] Includes 113,000 M cubic feet consumed in Mexico.

[4] 1927: Alaska, Maryland (consumption only), Mississippi, and Utah; 1928: Alaska, Maryland (consumption only), Mississippi, North Dakota, and Tennessee.

[5] Includes 84,000 M cubic feet consumed in Canada.

[6] Includes 76,000 M cubic feet consumed in Mexico.

DOMESTIC CONSUMPTION

The total number of domestic (household) consumers increased from 3,984,400 in 1927to 4,343,500 in 1928, or 9 per cent. (See fig. 4.) The most important increases occurred in Colorado, following the completion of the Panhandle-Denver line; in Louisiana, after the opening of the Monroe-New Orleans line; and in Texas, following a general expansion of distributing facilities throughout the State. Michigan made a notable gain in number of consumers, following the development of considerable production near Muskegon. Ohio continued to lead in the number of domestic consumers and was again followed by California and Pennsylvania. Each of these three States reported an increase in 1928 in the number of domestic consumers, although in percentage of increase they were greatly exceeded by less important States through which trunk lines were laid during the year.

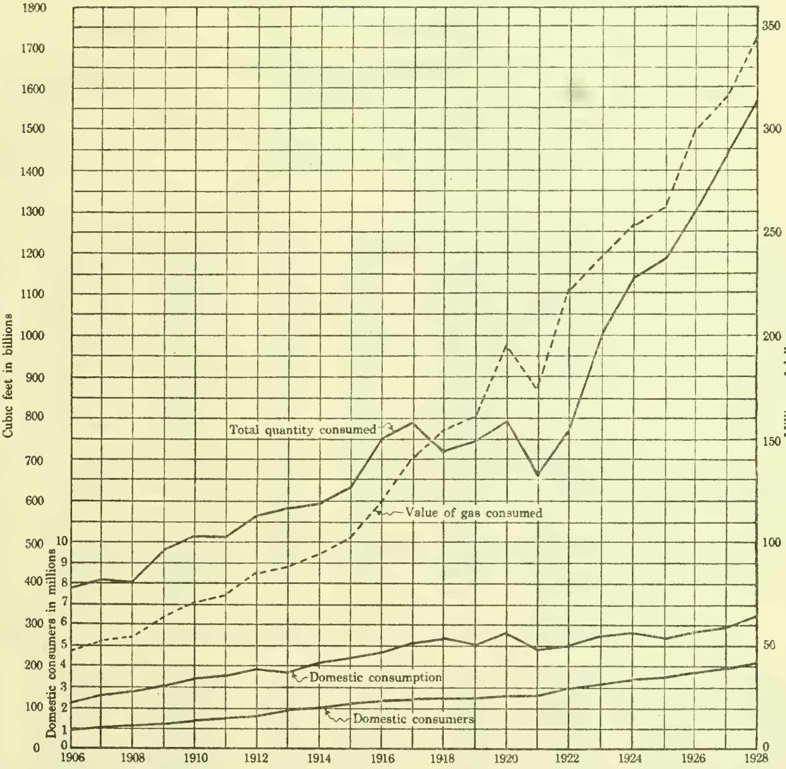

FIGURE 4.—Growth of natural-gas consumption in the United States, 1906–1928

The total consumption of natural gas by domestic consumers in 1928 amounted to 320,877,000,000 cubic feet, or 20 per cent of the total consumption, and an increase over 1927 of 8 per cent. The average consumption per domestic consumer was lowered for the sixth successive year; it amounted to 73,900 cubic feet in 1928, as compared with 74,300 cubic feet in 1927. This decline may have been due to more efficient use, but had the new trunk lines been in operation the entire year it is probable that the average consumption would have increased.

The average price paid for natural gas by domestic consumers continued its slow increase and amounted to 62 cents per thousand cubic feet in 1928. This price compares with 60.8 cents in 1927 and 58.4 cents in 1926. On the basis of the consumption and price data given, the natural-gas bill of the average domestic consumer in 1928 was $3.82 per month as compared with $3.76 per month in 1927 and $2.83 in 1918.

Natural gas consumed in the United States, 1927–28, by States

State	Domestic				Industrial		
	Number of consumers	M cubic feet	Value at points of consumption		M cubic feet	Value at points of consumption	
			Total	Average (cents)		Total	Average (cents)
1927							
Arkansas	57,190	6,419,000	$2,900,000	45.2	34,497,000	$2,851,000	8.3
California	745,440	35,309,000	30,125,000	85.3	177,055,000	20,821,000	11.8
Colorado	2,050	179,000	105,000	58.7	1,365,000	172,000	12.6
Illinois	12,150	164,000	116,000	70.7	3,577,000	648,000	18.1
Indiana	13,850	781,000	415,000	53.1	1,385,000	661,000	47.7
Kansas	145,960	10,435,000	6,893,000	66.1	56,183,000	7,105,000	12.6
Kentucky	141,880	11,448,000	4,917,000	43.0	5,246,000	691,000	13.2
Louisiana	40,480	4,071,000	1,482,000	36.4	166,239,000	7,858,000	4.7
Michigan	10	600	300	50.0	----------	----------	--------
Missouri	99,070	5,359,300	4,841,000	90.3	1,225,000	424,000	34.6
Montana	7,700	1,775,000	763,000	43.0	3,680,000	155,000	4.2
New Mexico	140	21,000	4,500	21.4	998,000	44,000	4.4
New York	236,890	15,036,000	10,087,000	67.1	1,138,500	427,000	37.5
North Dakota	30	2,300	1,300	56.5	----------	----------	--------
Ohio	1,149,760	83,654,000	52,038,000	62.2	28,949,000	12,220,000	42.2
Oklahoma	193,660	22,298,000	10,532,000	47.2	264,187,000	22,971,000	8.7
Pennsylvania	610,720	51,794,000	31,389,000	60.6	70,188,000	23,084,000	32.9
South Dakota	400	92,000	136,500	148.4	----------	----------	--------
Tennessee	70	9,000	2,200	24.4	----------	----------	--------
Texas	328,510	20,517,000	14,019,000	68.3	249,427,000	26,122,000	10.5
West Virginia	171,370	23,406,000	7,673,000	32.8	42,794,000	9,409,000	22.0
Wyoming	12,780	2,638,000	1,070,000	40.6	39,921,000	2,010,000	5.0
Other[1]	14,290	627,800	508,200	80.9	1,153,500	112,000	9.7
	3,984,400	296,036,000	180,018,000	60.8	1,149,208,000	137,785,000	12.0
1928							
Arkansas	57,640	6,785,000	3,281,000	48.4	30,978,000	3,366,000	10.9
California	769,190	37,702,000	32,987,000	87.5	208,513,000	23,708,000	11.4
Colorado	69,030	629,000	697,000	110.8	5,718,000	1,150,000	20.1
Illinois	12,130	52,000	46,000	88.5	2,999,000	314,000	10.5
Indiana	15,910	791,000	490,000	61.9	1,468,000	711,000	48.4
Kansas	160,370	12,008,000	7,876,000	65.6	60,663,000	9,135,000	15.1
Kentucky	140,520	10,753,000	4,874,000	45.3	5,049,000	1,594,000	31.6
Louisiana	107,510	6,127,000	2,777,000	45.3	182,628,000	10,359,000	5.7
Michigan	9,600	60,000	90,000	150.0	409,000	59,000	14.4
Missouri	99,430	6,129,000	5,074,000	82.8	3,637,000	828,000	22.8
Montana	13,180	2,346,000	1,010,000	43.1	4,919,000	514,000	10.4
New Mexico	530	47,000	23,000	48.9	807,000	44,000	5.5
New York	241,660	16,391,000	11,229,000	68.5	1,527,000	746,000	48.9
Ohio	1,192,500	88,511,000	55,540,000	62.7	33,973,000	14,755,000	43.4
Oklahoma	216,000	23,185,000	11,811,000	50.9	262,148,000	27,034,000	10.3
Pennsylvania	615,360	52,971,000	32,409,000	61.2	63,179,000	21,979,000	34.8
South Dakota	2,470	214,000	212,000	99.1	----------	----------	--------
Texas	420,060	27,284,000	18,305,000	67.1	291,434,000	35,965,000	12.3
Utah	----------	----------	----------	--------	1,105,000	22,000	2.0
West Virginia	171,690	25,407,000	8,394,000	33.0	41,865,000	10,237,000	24.5
Wyoming	12,680	2,729,000	1,071,000	39.2	43,820,000	2,219,000	5.1
Other[1]	16,040	756,000	612,000	81.0	263,000	84,000	31.9
	4,343,500	320,877,000	198,808,000	62.0	1,247,102,000	164,823,000	13.2

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[1] 1927: Alaska, Maryland, Mississippi, and Utah; 1928: Alaska, Maryland, Mississippi, North Dakota, and Tennessee.

INDUSTRIAL CONSUMPTION

The total consumption of natural gas for industrial purposes in 1928 amounted to 1,247,102,000,000 cubic feet, an increase over 1927 of 9 per cent. (See fig. 5.) Of the total, 573,698,000,000 cubic feet, or 46 per cent, was used for field purposes (that is, for drilling, pumping, etc.); 175,137,000,000 cubic feet, or 14 per cent, was burned for carbon black; 114,950,000,000 cubic feet, or 9 per cent, was used for fuel in the refining of petroleum; and 77,326,000,000 cubic feet,

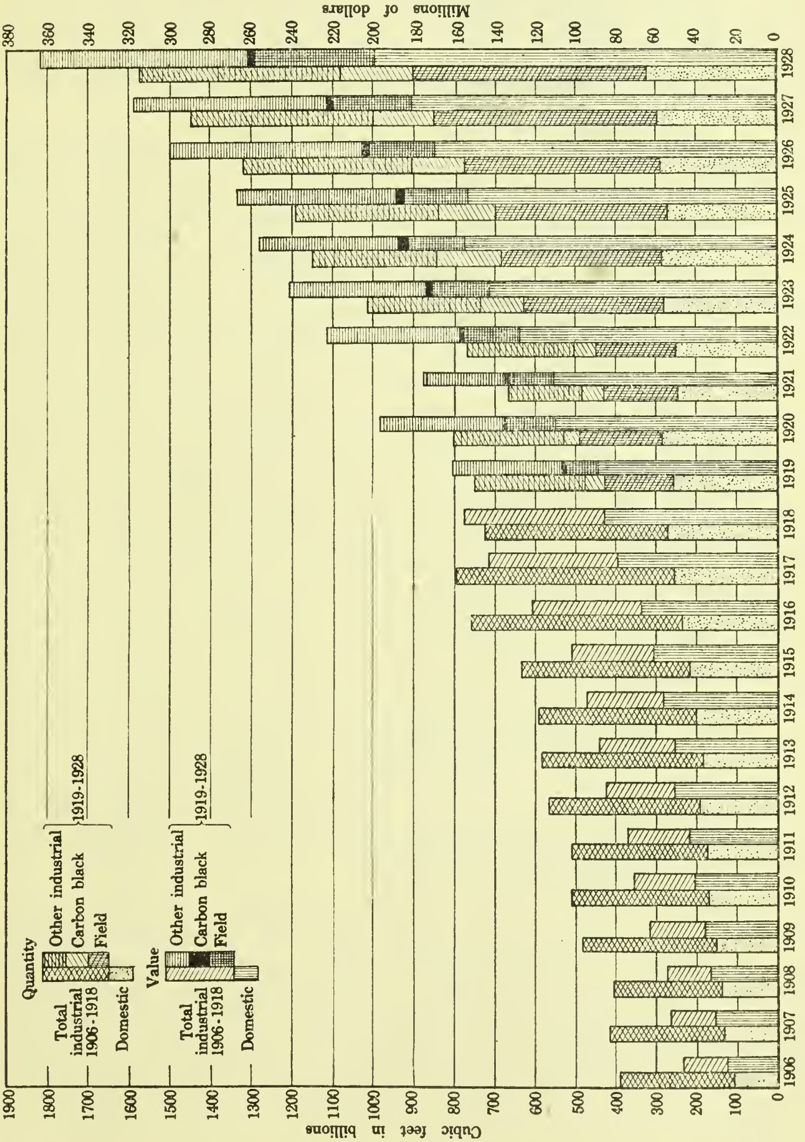

FIGURE 5.—Quantity and value of natural gas consumed in the United States, 1906–1928

or 6 per cent, was burned as fuel by electric public-utility power plants, leaving 305,991,000,000 cubic feet, or 25 per cent, for "other industrial" purposes.

The average price per thousand cubic feet paid for natural gas for industrial purposes in 1928 was 13.2 cents, as compared with 12 cents in 1927 and 12.8 cents in 1926. The increase in average price of gas for industrial use was due entirely to the reported increased price of gas for field purposes; in fact, the price of gas for industrial purposes other than field use declined from 16.5 cents per thousand cubic feet in 1927 to 15.8 cents in 1928.

The consumption of natural gas for field purposes in 1928 amounted to 573,698,000,000 cubic feet, an increase over 1927 of 24,243,000,000 cubic feet, or 4 per cent. California was credited with an increase of nearly 28,000,000,000 cubic feet in field use of natural gas in 1928, or more than the increase for the country as a whole. The other two major oil-producing States, Texas and Oklahoma, recorded but small increases in field use of natural gas—in Oklahoma, probably because of the decline in drilling but in Texas, in view of the material increase in the number of completions in 1928, probably because some gas was displaced by fuel oil for field use. The total value of the natural gas sold for field purposes amounted to $58,356,000, an average of 10.2 cents per thousand cubic feet, in 1928 as compared with $38,912,000, an average of 7.1 cents, in 1927. This apparent increase was largely due to a change in the method of reporting the value.

The consumption of natural gas in the manufacture of carbon black constituted the second largest item among the industrial uses listed. The total quantity used in the manufacture of carbon black in 1928 amounted to 175,137,000,000 cubic feet, an increase over 1927 of 31,050,000,000 cubic feet, or 22 per cent. Although 60 per cent of the total used for carbon black was burned in the Monroe district of Louisiana, the Panhandle area of Texas made a material gain in 1928 and bids fair to take first place from the Monroe district in the near future. The total value of the natural gas burned for carbon black in 1928 amounted to $4,321,000, an average of 2.5 cents per thousand cubic feet, as compared with 2.8 cents in 1927. The average price in Louisiana was virtually unchanged; the average price in Texas decreased from 3.1 cents in 1927 to 2.5 in 1928, and this decrease was largely responsible for the decline in the average for the country as a whole.

The use of natural gas as a fuel at refineries, which has been increasing quite rapidly, declined in 1928; the total used in that year amounted to 114,950,000,000 cubic feet, as compared with 123,395,000,000 cubic feet in 1927. The largest factor in the total decline was the displacement of about 7,500,000,000 cubic feet of gas in Oklahoma by slightly over 1,000,000 barrels of fuel oil. Fuel-oil prices were low in 1928, and some refiners considered it economical to use their surplus oil in place of gas rather than sell the oil on a weak market.

The United States Geological Survey reports the consumption of natural gas for fuel in the generation of electric power by public-utility plants in 1928 as 77,326,408,000 cubic feet, an increase over 1927 of 14,407,211,000 cubic feet, or 23 per cent. Texas led in 1928 in the use of natural gas for generating electricity, California was second, and Louisiana was third.

Industrial consumption of natural gas in the United States, 1927–28, by States and uses

[Figures on consumption by public utilities from U. S. Geological Survey; others partly estimated]

State	Field (drilling, pumping, and operating gasoline recovery plants)		Manufacture of carbon black			Fuel at petroleum refineries, fuel at electric public-utility power plants, and other industrial				
	M cubic feet (estimated)	Value at points of consumption (estimated)	M cubic feet	Value at points of consumption		M cubic feet			Value at points of consumption	
				Total	Average (cents)	Petroleum refineries	Electric public-utility power plants	Other industrial	Total	Average (cents)
1927										
Arkansas	20,876,000	$1,019,000				3,542,000	1,738,000	8,341,000	$1,832,000	13.4
California	121,393,000	11,107,000				17,831,000	7,140,000	30,691,000	9,714,000	17.5
Colorado	1,203,000	120,000				6,000		156,000	52,000	32.1
Illinois	3,577,000	648,000								
Indiana	97,000	35,000						1,288,000	626,000	48.6
Kansas	15,811,000	1,210,000				7,398,000	8,698,000	24,276,000	5,895,000	14.6
Kentucky	861,000	80,000	3,187,000	$244,000	7.7		14,000	1,184,000	367,000	30.6
Louisiana	27,672,000	830,000	96,150,000	2,338,000	2.4	21,703,000	6,138,000	14,576,000	4,690,000	11.1
Missouri								1,225,000	424,000	34.6
Montana	1,203,000	37,000	2,049,000	41,000	2.0	214,000	214,000		77,000	18.0
New Mexico	998,000	44,000								
New York	464,500	14,000				2,000	19,000	653,000	413,000	61.3
Ohio	3,679,000	618,000				6,000	5,519,000	19,745,000	11,602,000	45.9
Oklahoma	204,006,000	13,424,000				23,630,000	7,967,000	28,584,000	9,547,000	15.9
Pennsylvania	7,990,000	2,003,000				1,727,000	106,000	60,365,000	21,081,000	33.9
Texas	103,498,000	4,564,000	35,495,000	1,117,000	3.1	32,004,000	24,905,000	53,525,000	20,441,000	18.5
West Virginia	15,864,000	2,337,000	1,921,000	174,000	9.1	812,000	159,000	24,038,000	6,898,000	27.6
Wyoming	20,224,000	819,000	4,394,000	132,000	3.0	14,520,000	302,000	481,000	1,059,000	6.9
Other [1]	38,500	3,000	891,000	18,000	2.0			224,000	91,000	40.6
	549,455,000	38,912,000	144,087,000	4,064,000	2.8	123,395,000	62,919,000	269,352,000	94,809,000	20.8

[1] Alaska, Maryland, and Utah.

Industrial consumption of natural gas in the United States, 1927–28, by States and uses—Continued

State	Field (drilling, pumping, and operating gasoline recovery plants)		Manufacture of carbon black			Fuel at petroleum refineries, fuel at electric public-utility power plants, and other industrial				
	M cubic feet (estimated)	Value at points of consumption (estimated)	M cubic feet	Value at points of consumption		M cubic feet			Value at points of consumption	
				Total	Average (cents)	Petroleum refineries	Electric public-utility power plants	Other industrial	Total	Average (cents)
1928										
Arkansas	13,728,000	$1,086,000				3,737,000	1,573,000	11,940,000	$2,280,000	13.2
California	149,307,000	13,273,000				17,403,000	12,849,000	28,954,000	10,435,000	17.6
Colorado	1,180,000	118,000				4,000		4,534,000	1,032,000	22.7
Illinois	2,931,000	295,000						68,000	19,000	27.9
Indiana	85,000	9,000						1,383,000	702,000	50.8
Kansas	14,782,000	1,380,000				7,171,000	8,838,000	29,872,000	7,755,000	16.9
Kentucky	968,000	112,000	218,000	$22,000	10.1		16,000	3,847,000	1,460,000	37.8
Louisiana	26,004,000	1,211,000	104,670,000	2,473,000	2.4	22,034,000	10,138,000	19,782,000	6,675,000	12.8
Michigan	99,000	9,000						310,000	50,000	16.1
Missouri	8,000	1,000						3,629,000	827,000	22.8
Montana	1,116,000	106,000	1,760,000	35,000	2.0	351,000	612,000	1,080,000	373,000	18.3
New Mexico	772,000	39,000				27,000		8,000	5,000	14.3
New York	716,000	238,000					20,000	791,000	508,000	62.6
Ohio	3,850,000	1,406,000					4,206,000	25,917,000	13,349,000	44.3
Oklahoma	205,159,000	19,474,000				16,184,000	8,709,000	32,096,000	7,560,000	13.3
Pennsylvania	6,606,000	2,229,000				1,173,000	73,000	55,327,000	19,750,000	34.9
Texas	106,034,000	12,749,000	62,749,000	1,576,000	2.5	29,641,000	29,886,000	63,124,000	21,640,000	17.6
Utah			1,105,000	22,000	2.0					
West Virginia	17,876,000	3,767,000	494,000	69,000	14.0	1,519,000	187,000	21,789,000	6,401,000	27.2
Wyoming	22,473,000	853,000	4,141,000	124,000	3.0	15,706,000	219,000	1,281,000	1,242,000	7.2
Other [1]	4,000	1,000						259,000	83,000	32.0
	573,698,000	58,356,000	175,137,000	4,321,000	2.5	114,950,000	77,326,000	305,991,000	102,146,000	20.5

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[1] Alaska, Maryland, Mississippi, and North Dakota.

INTERSTATE TRANSPORTATION

The interstate movement of natural gas increased materially in 1928 when a total of 241,386,000,000 cubic feet was transported from State to State and to Canada and Mexico, as compared with 194,401,000,000 cubic feet in 1927. (See fig. 6.) The movement of natural gas from West Virginia to Ohio continued to rank first in importance, although some recently established interstate deliveries—from Louisiana to Texas, for example—showed a larger increase in

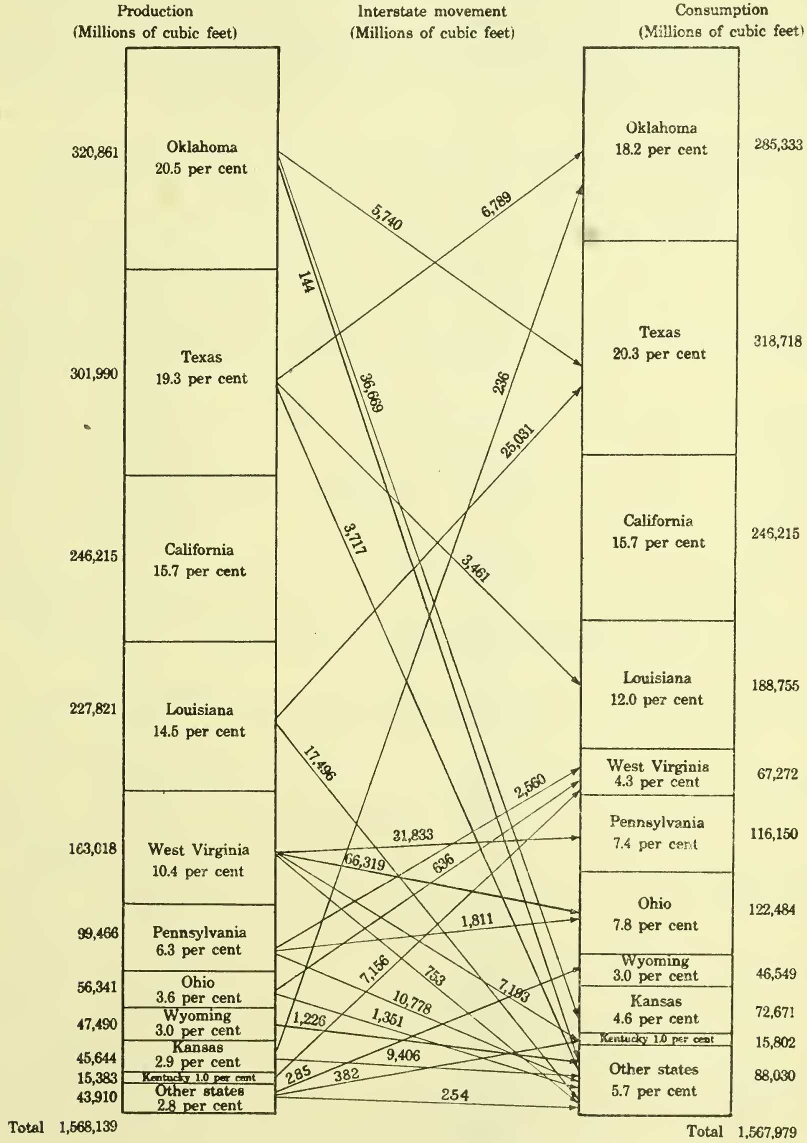

FIGURE 6.—Interstate movement of natural gas in the United States in 1928 and relative importance of principal States in production and consumption

1928. The total moved from West Virginia to Ohio in 1928 was 66,319,000,000 cubic feet, 41 per cent of the total production in West Virginia and the equivalent of 118 per cent of the output in Ohio.

The completion of several long trunk pipe lines crossing several States—the line from the Panhandle district to Denver, for example—resulted in a number of new interstate movements of natural gas, as follows: 16,000,000 cubic feet from Colorado to New Mexico; 160,000,000 cubic feet from Montana to South Dakota; 3,717,000,000 cubic feet from Texas to Colorado; and 6,789,000,000 cubic feet from Texas to Oklahoma.

Interstate transportation of natural gas, 1927–28, in thousands of cubic feet

State in which gas was produced	State to which gas was transported	1927	1928
Colorado	New Mexico		16,000
	Wyoming	181,400	285,000
		181,400	301,000
Indiana	Kentucky	306,000	382,000
Kansas	Missouri	6,584,000	9,406,000
	Oklahoma	104,000	236,000
		6,688,000	9,642,000
Kentucky	West Virginia	1,955,000	7,156,000
Louisiana	Arkansas	10,215,000	17,384,000
	Mississippi	14,000	112,000
	Texas	10,884,000	25,031,000
		21,113,000	42,527,000
Montana	North Dakota	2,100	78,000
	South Dakota		160,000
		2,100	238,000
New York	Canada	71,000	84,000
	Pennsylvania	500	
		71,500	84,000
Ohio	Indiana	1,348,000	1,351,000
	West Virginia	1,102,000	636,000
		2,450,000	1,987,000
Oklahoma	Arkansas	251,000	144,000
	Kansas	30,660,000	36,669,000
	Texas	9,572,000	5,740,000
		40,483,000	42,553,000
Pennsylvania	New York	10,338,000	10,778,000
	Ohio	1,698,000	1,811,000
	West Virginia	2,052,000	2,560,000
		14,088,000	15,149,000
Texas	Colorado		3,717,000
	Louisiana	4,462,000	3,461,000
	Mexico	113,000	76,000
	Oklahoma		6,789,000
		4,575,000	14,043,000
West Virginia	Kentucky	8,137,000	7,193,000
	Maryland	813,000	753,000
	Ohio	61,974,000	66,319,000
	Pennsylvania	30,360,000	31,833,000
		101,284,000	106,098,000
Wyoming	Montana	1,204,000	1,226,000
		194,401,000	241,386,000

NATURAL-GAS WELLS

During 1928, 2,727 gas wells were completed in the United States, exclusive of California (for which State the record is lacking), as compared with 2,491 in 1927, an increase of 236 or 9 per cent. It is worthy of note that this increase is very close to the increase of 8 per cent in production.

The following States led in 1928 in number of gas-well completions: Texas, with 558; Ohio, with 515; Oklahoma, with 491; and West Virginia, with 404. The completions in these States comprised 72 per cent of the total for the country. Some of the States with comparatively small production had a disproportionately large number of completions. The output of these States, however, did not show material increase because the wells, almost without exception, were small and because the supply of gas from oil-well completions was small in comparison with the supply from completions in States such as Texas and Oklahoma.

Important counties or districts with respect to number of gas-well completions in 1928 were as follows: The Mirando district of Texas, with 119 completions; Grady County, Okla., with 99; Athens County, Ohio, with 86; and Boone County W. Va., with 74.

Gas wells drilled in the United States in 1928, by States and by counties or districts[1]

State and county or district	Number of gas wells
Arkansas:	
Franklin	1
Johnson	6
Nevada	1
Ouachita	3
Union	18
	29
Total for 1927	46
California	(2)
Colorado:	
Las Animas	1
	1
Total for 1927	7
Illinois:	
Crawford	6
Wabash	2
	8
Total for 1927	8
Indiana:	
Allen	2
Decatur	6
Floyd	1
Gibson	5
Harrison	10
Lagrange	1
Madison	1
Martin	1
Pike	4
Rush	5
Spencer	1
Sullivan	1
	38
Total for 1927	31
Kansas:	
Anderson	1
Barber	1
Bourbon	4
Chase	1
Chautauqua-Elk	14
Clark	1
Coffey	3
Cowley	34
Franklin	2
Greenwood	12
Harvey	1
McPherson	11
Miami	1
Montgomery	11
Morris	3
Russell	1
Seward	2
Sumner	12
	115
Total for 1927	79
Kentucky:	
Caldwell	1
Clay	2
Daviess	8
Floyd-Knott	10
Hancock	1
Hopkins	1
Johnson	2
Knox	1
Lee-Owsley	3
Metcalfe	2
Ohio	15
Union	1
Webster	1
	48
Total for 1927	40

[1] Oil and Gas Journal.

reported.

Gas wells drilled in the United States in 1928, by States and by counties or districts—Continued

State and county or district	Number of gas wells
Louisiana:	
Gulf coast—	
Edgerley	1
Vinton	1
Miscellaneous	2
	4
Total for 1927	3
Northern—	
Bienville	1
Bossier	49
Caddo	6
De Soto	8
East Carroll	1
Morehouse	20
Ouachita	36
Richland	43
Union	19
Webster	46
	229
Total for 1927	177
Total Louisiana, 1928	233
1927	180
Michigan:	
Mason	1
Muskegon	28
	29
Total for 1927	3
Mississippi:	
Monroe	1
	1
Total for 1927	1
Montana:	
Big Horn	1
Fallon	7
Kevin-Sunburst	45
Liberty	1
Pondera	1
Stillwater	1
	56
Total for 1927	54
New Mexico:	
Eddy	1
San Juan	5
	6
Total for 1927	6
Ohio:	
Central and eastern—	
Ashland	48
Ashtabula	1
Athens	86
Coshocton	20
Cuyahoga	20
Fairfield	5
Gallia	11
Guernsey	8
Hocking	6
Holmes	47
Jackson	18
Knox	20
Lawrence	3
Licking	23
Lorain	15
Medina	18
Meigs	23
Monroe	4
Morgan	6
Muskingum	9
Noble	6
Perry	21
Ohio—Continued.	
Central and eastern—Continued.	
Richland	3
Stark	2
Summit	28
Vinton	2
Washington	15
Wayne	28
	496
Total for 1927	433
Northwestern—	
Darke	1
Hancock	1
Hardin	8
Lucas	1
Mercer	2
Ottawa	2
Sandusky	1
Seneca	1
Wood	1
Wyandot	1
	19
Total for 1927	16
Total Ohio, 1928	515
1927	449
Oklahoma:	
Beckham	10
Caddo	1
Carter	3
Cotton	1
Creek	42
Garfield	1
Garvin	1
Grady	99
Grant	5
Hughes	3
Jefferson	2
Kay	59
Le Flore	2
Lincoln	1
Logan	6
McIntosh	1
Mayes	1
Muskogee	40
Noble	1
Nowata	2
Okfuskee	12
Okmulgee	52
Osage	35
Pawnee	11
Payne	2
Pittsburg	6
Pontotoc	17
Pottawatomie	4
Rogers	5
Seminole	18
Sequoyah	2
Stephens	21
Texas	1
Tulsa	14
Wagoner	9
Washington	1
	491
Total for 1927	508
Northwest Pennsylvania and New York:	
Allegany	6
Bradford	11
Butler-Armstrong	24
Middle Field	2
Venango-Clarion	66
	101
Total for 1927	109

Gas wells drilled in the United States in 1928, by States and by counties or districts—Continued

State and county or district	Number of gas wells
Southwestern Pennsylvania:	
Allegheny	16
Butler	1
Greene	38
Washington	4
Westmoreland	1
	60
Total for 1927	89
Tennessee:	
Clay	5
Overton	1
Putnam	1
	7
Total for 1927	2
Texas:	
Gulf coast—	
Boling	2
Dewalt	2
Hull	1
Liberty	1
Raccoon Bend	2
Miscellaneous	3
	11
Total for 1927	13
Rest of State—	
North central, eastern, and southwestern—	
Adams (Medina County)	4
Agua Dulce	3
Anderson	2
Brown	29
Callahan	4
Clay	2
Coleman	30
Comanche	5
Cooke	1
Eastland	28
Erath	4
Foard	1
Harrison	21
Kingsville	3
Limestone	2
McCulloch	3
Mirando	119
Montague	6
Palo Pinto	9
Panola	60
Refugio	32
Shackelford	8
Stephens	16
White Point	17
Wilbarger	2
Young	1
Miscellaneous	22
	434
Total for 1927	346
Panhandle—	
Carson	15
Gray	29
Hartley	1
Hutchinson	8
Moore	5
Potter	7
Texas—Continued.	
Rest of State—Continued.	
Panhandle—Continued.	
Wheeler	35
	100
Total for 1927	94
West Texas—	
Crockett	1
Howard	2
Runnels	1
Winkler	9
	13
Total for 1927	6
Total "Rest of State," 1928	547
1927	446
Total Texas, 1928	558
1927	459
Utah:	
Grand	4
Uintah	1
	5
Total for 1927	1
West Virginia:	
Boone	74
Braxton	3
Cabell	26
Calhoun	37
Clay	5
Doddridge	6
Gilmer	17
Harrison	16
Jackson	2
Kanawha	16
Lewis	16
Lincoln	60
Logan	2
Marion	16
Marshall	8
Mingo	6
Monongalia	3
Putnam	10
Ritchie	37
Roane	12
Wayne	10
Wetzel-Tyler	18
Wirt	4
	404
Total for 1927	408
Wyoming:	
Big Horn	1
Carbon	3
Fremont	2
Natrona (except Salt Creek)	2
Niobrara	1
Park	1
Sublette	2
Sweetwater	2
	14
Total for 1927	19
Total United States, 1928	2,727
1927	2,491

ASPHALT AND RELATED BITUMENS[1]

By A. H. Redfield

SUMMARY TABLES

Supply and distribution of asphalt and related bitumens in the United States 1925–1928, in short tons

	1925	1926	1927	1928
SUPPLY				
Native asphalt and related bitumens:				
Produced	584,850	715,180	839,040	807,860
Imported (chiefly lake asphalt)	122,162	142,632	158,097	119,588
Petroleum asphalt (excluding road oil):				
Produced at refineries from—				
Domestic petroleum	1,048,118	1,031,696	1,304,522	1,392,355
Foreign petroleum	1,890,860	2,209,401	2,513,017	2,156,172
	2,938,978	3,241,097	3,817,539	3,548,527
Stocks, Jan. 1	97,300	159,400	193,300	220,800
Total supply	3,743,290	4,258,309	5,007,976	4,696,775
DISTRIBUTION				
Native asphalt and related bitumens:				
Indicated domestic demand	552,015	676,962	799,165	781,597
Exports (unmanufactured)	32,835	38,218	39,875	26,263
Petroleum asphalt (excluding road oil):				
Indicated domestic demand (including lake asphalt)	2,910,026	3,203,240	3,563,105	3,161,153
Exports	89,014	146,589	385,031	492,362
Stocks, Dec. 31	159,400	193,300	220,800	235,400
Total distribution	3,743,290	4,258,309	5,007,976	4,696,775

Values of principal items of asphalt and related bitumens industry in the United States, 1925–1928

	1925	1926	1927	1928
Native asphalt and related bitumens:				
Sales	$4,148,400	$4,484,960	$5,605,850	$5,175,055
Imports (chiefly lake asphalt)	907,424	1,045,596	1,140,425	865,046
Exports (unmanufactured)	825,654	905,743	1,034,334	683,563
Petroleum asphalt:				
Sales (including road oil) from—				
Domestic petroleum	15,305,760	15,452,940	19,019,150	20,425,371
Foreign petroleum	27,520,010	31,098,460	35,771,940	29,687,614
Total sales	42,825,770	46,551,400	54,791,090	50,112,985
Exports	1,762,048	3,183,746	8,325,413	9,788,501

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[1] Work on manuscript completed December, 1929.

Asphalt sold by producers at mines or refineries in the United States, 1919–1928

[Value f. o. b. mine or refinery]

Year	Native asphalt and related bitumens		Manufactured asphalt (including road oil)					
			From domestic petroleum		From foreign petroleum		Total	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1919	88, 281	$682, 989	614, 692	$8, 727, 372	674, 876	$7, 711, 510	1, 289, 568	$16, 438, 882
1920	198, 497	1, 213, 908	700, 496	11, 985, 457	1, 045, 779	14, 272, 862	1, 746, 275	26, 258, 319
1921	296, 412	1, 985, 583	624, 220	9, 048, 221	908, 093	11, 761, 358	1, 532, 313	20, 809, 579
1922	327, 792	2, 253, 180	805, 145	10, 385, 925	1, 242, 163	13, 899, 407	2, 047, 308	24, 285, 332
1923	400, 236	2, 885, 631	995, 654	13, 060, 174	1, 378, 722	16, 840, 045	2, 374, 376	29, 900, 219
1924	562, 367	3, 958, 339	1, 158, 456	14, 305, 007	1, 920, 915	21, 710, 793	3, 079, 371	36, 015, 800
1925	584, 850	4, 148, 400	1, 206, 700	15, 305, 760	1, 971, 670	27, 520, 010	3, 178, 370	42, 825, 770
1926	715, 180	4, 484, 960	1, 245, 160	15, 452, 940	2, 213, 310	31, 098, 460	3, 458, 470	46, 551, 400
1927	839, 040	5, 605, 850	1, 525, 420	19, 019, 150	2, 426, 030	35, 771, 940	3, 951, 450	54, 791, 090
1928	807, 860	5, 175, 055	1, 741, 392	20, 425, 371	2, 264, 137	29, 687, 614	4, 005, 529	50, 112, 985

NATIVE ASPHALTS AND BITUMENS

BITUMINOUS ROCK

SALES

Unfavorable weather conditions were instrumental in causing the total sales of bituminous rock in the United States to decrease 4.5 per cent in quantity (from 796,100 short tons in 1927 to 760,497 tons in 1928) and 13.1 per cent in value (from $4,672,280 in 1927 to $4,060,276 in 1928). Two States, Texas and Kentucky, furnished 84 per cent of the total production in 1928.

In west-central Kentucky, chiefly in Edmonson, Grayson, and Hardin Counties, sandstone of lowest Pennsylvanian age, containing 5 to 12 per cent of bitumen, is mined in open quarries. Five companies were active in 1928: The Crown Rock Asphalt Co., operating at Big Clifty, Grayson County; the Kentucky Rock Asphalt Co., at Kyrock, Edmonson County; the Natural Rock Asphalt Corporation, at Natural Rock, Edmonson County; the Ohio Valley Rock Asphalt Co., at Summit, Hardin County; and the United Rock Asphalt Co., at Asphalt, Edmonson County. In Edmonson County the bituminous rock is mined, crushed, milled, and screened, then floated on barges down Nolin and Green Rivers and up Big Barren River about 70 miles to Bowling Green on the Louisville & Nashville Railroad, or about 100 miles to Rockport on the Illinois Central Railroad. It is shipped to destinations both north and south of the Ohio River, but chiefly east of the Mississippi River. As shipped from the quarries, Kentucky rock asphalt contains 7 per cent of bitumen, and may be laid cold without further treatment.

Sales of bituminous sandstone mined in Kentucky decreased 7.5 per cent in quantity (from 344,220 short tons in 1927 to 318,548 tons in 1928) and 12.6 per cent in value (from $3,156,700 in 1927 to $2,757,547 in 1928). Although business conditions were considered as good in 1928 as in 1927, bad weather made the selling season short. The prices obtained averaged $8.66 per short ton, a decrease of 5.6 per cent from the $9.17 selling price in 1927.

In southwestern Texas almost horizontal beds of coarse-grained yellow limestone belonging to the Ancacho formation (upper Cretaceous) and containing 8½ to 20 per cent of bitumen are quarried in Uvalde and Kinney Counties. Three companies operated in 1928: The Texas Rock Asphalt Co., near Uvalde; the Uvalde Rock Asphalt Co., near Blewett; and White's Uvalde Mines, 10 miles south of Cline. As shipped from the quarries, Texas rock asphalt contains 9½ to 10½ per cent of bitumen, and may be laid by either the hot or the cold process.

Sales of bituminous limestone mined in Texas decreased 14.7 per cent in quantity (from 376,770 short tons in 1927 to 321,505 tons in 1928) and 35 per cent in value (from $1,254,500 in 1927 to $815,482 in 1928). Unfavorable weather conditions and slackened demand caused the average price per short ton to decrease from $3.33 in 1927 to $2.54 in 1928, or 23.7 per cent.

Native asphalt and related bitumens sold at mines in the United States, 1924–1928, by varieties and by States

[Value f. o. b. mine]

	1924		1925		1926		1927		1928	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Bituminous rock:										
Alabama	8,498	$29,743	23,550	$77,080	22,000	$101,000	32,650	$128,700	110,360	$406,575
Oklahoma	17,961	80,825	27,450	82,830	37,010	121,830	42,460	132,380		
California	3,731	14,088	2,680	16,100	3,330	19,310				
Kentucky	274,743	2,386,557	286,850	2,493,360	320,430	2,530,480	344,220	3,156,700	318,548	2,757,547
Missouri	300	3,150	----------	----------	----------	----------	----------	----------	----------	----------
Texas	220,598	779,696	204,530	692,730	289,980	825,610	376,770	1,254,500	321,505	815,482
Utah	----------	----------	----------	----------	----------	----------	----------	----------	10,084	80,672
Total bituminous rock	525,831	3,294,059	545,060	3,362,100	672,750	3,598,230	796,100	4,672,280	760,497	4,060,276
Gilsonite: Utah	35,907	603,620	39,520	767,900	42,190	863,840	42,580	876,820	47,023	1,037,679
Grahamite: Utah	60	450	----------	----------	----------	----------	----------	----------	----------	----------
Ozokerite: Utah	300	36,000	----------	----------	----------	----------	80	32,000	150	60,000
Wurtzilite: Utah	269	24,210	270	18,400	240	22,890	280	24,750	190	17,100
Grand total	562,367	3,958,339	584,850	4,148,400	715,180	4,484,960	839,040	5,605,850	807,860	5,175,055
RÉSUMÉ BY STATES										
Alabama	8,498	29,743	23,550	77,080	22,000	101,000	32,650	128,700	110,360	406,575
Oklahoma	17,961	80,825	27,450	82,830	37,010	121,830	42,460	132,380		
California	3,731	14,088	2,680	16,100	3,330	19,310				
Kentucky	274,743	2,386,557	286,850	2,493,360	320,430	2,530,480	344,220	3,156,700	318,548	2,757,547
Missouri	300	3,150	----------	----------	----------	----------	----------	----------	----------	----------
Texas	220,598	779,696	204,530	692,730	289,980	825,610	376,770	1,254,500	321,505	815,482
Utah	36,536	664,280	39,790	786,300	42,430	886,730	42,940	933,570	57,447	1,195,451
Grand total	562,367	3,958,339	584,850	4,148,400	715,180	4,484,960	839,040	5,605,850	807,860	5,175,055

Relatively minor amounts of rock asphalt are quarried in Alabama, Oklahoma, California, and Utah. In northern Alabama limestone of middle Mississippian age, containing various small percentages of bitumen, has been quarried for years. Two companies were active in 1928: The Colbert Limerock Asphalt Co., operating at Colrock, 15 miles west of Sheffield, on the main line of the Southern Railroad, and the Alabama Rock Asphalt (Inc.), operating at Margerum, 8 miles west of Colrock. The richer rock, containing from 2.5 to 9.5 per cent of bitumen, is sorted out by hand, crushed, and shipped for use as paving material; the remainder is sold for use as crushed stone. The more bituminous material is mixed at its destination with 4 to 5 per cent of petroleum asphalt to raise its bitumen content to the percentage required for paving. It is then heated to 350° F. and laid immediately; or, by the more recently adopted "cold process," the bitumen is softened by the use of commercial naphtha as a solvent and laid while still soft, to harden gradually as the solvent evaporates.

In the Arbuckle Mountains of southern Oklahoma, steeply dipping beds of bituminous limestone and sandstone of Ordovician age have been quarried in Murray, Johnston, and Pontotoc Counties. Only one producer was active in 1928—the Western Paving Co., operating near Dougherty, Murray County. The bituminous limestone produced in Oklahoma contains 3 to 8 per cent of bitumen.

In Santa Cruz County, Calif., almost horizontal beds of loose, porous sandstone near the base of the Monterey diatomaceous shale (Miocene), containing 10 to 14 per cent of bitumen, have been mined in the mountains 5 miles northwest of Santa Cruz. Along the shores in Santa Barbara County, near Carpinteria, seepages of naphthene-base petroleum, escaping from the underlying Miocene, have impregnated Pleistocene sand with 18 to 20 per cent of bitumen. Two operators, the Bitumen Mines Operation near Santa Cruz and D. A. Sattler, lessee of the Huggins mine near Carpinteria, Santa Barbara County, furnished the entire production of California in 1928.

In Box Elder County, Utah, the Natural Bitumen Products Corporation, of San Francisco, is developing a deposit of soft natural asphalt that bubbles up from the bottom of Great Salt Lake near Rozel. This deposit has been described in Bulletin 260 of the United States Geological Survey, 1904, pages 468–473. In Carbon County, the Utah Rock Asphalt Corporation produced a small tonnage of rock asphalt in 1928 near Sunnyside.

DISTRIBUTION

The use of bituminous rock for paving is fairly widely distributed. In recent years Kentucky rock has been shipped as far east as Pawtucket, R. I., as far north as St. Paul, Minn., as far south as Florida, and to foreign countries; nevertheless, its greatest sales are made in Ohio, Kentucky, and West Virginia. Most of the Texas rock asphalt is sold in Texas and in the neighboring Southwestern States.

EXPORTS

Exports of natural asphalt and bituminous rock have never been large or relatively important. From 1920 to 1927 they represented only about 10 per cent of the natural bitumens produced in the United States and in 1928 only 3.3 per cent. They totaled in 1928 only 26,263 short tons, valued at $683,563, a decrease of 34.1 per cent in quantity and of 33.9 per cent in value from the 39,875 tons, valued at $1,034,334, that was exported in 1927.

In recent years countries of northern and western Europe have received 60 to 80 per cent of the total exports and Canada 12.5 to 18 per cent. Of the total foreign sales of unmanufactured natural asphalt and bitumen in 1928 only 45.7 per cent went to northern and western Europe, whereas 24.3 per cent went to Canada, 10 per cent to Australia and New Zealand, and 8.7 per cent to South America.

Although 49.5 per cent of the total exports in 1925 and 53 per cent in 1926 was shipped out of the Gulf coast ports, in 1928 only 41.9 per cent of the total was exported through these harbors. Similarly, the share of the Atlantic coast harbors in this foreign trade decreased from 27.3 per cent in 1925 and 25.1 per cent in 1926 to 20.4 per cent in 1928. On the other hand, shipments by rail over the northern border into Canada increased in relative importance from 17.6 per cent in 1925 and 11.8 per cent in 1926 to 24 per cent in 1928 and exports out of Pacific coast ports from 5.4 per cent in 1925 and 10.1 per cent in 1926 to 11.6 per cent in 1928.

GILSONITE

Gilsonite, a relatively pure natural asphalt distinguished by its hardness and its high fusing point, is produced commercially only in northeastern Utah, on the southern margin of the Uinta Basin. Here it fills parallel vertical fissures and veins cutting the Green River shale and the Bridger sandstone of Eocene age. These deposits have been described by W. J. Fene in Bureau of Mines Information Circular 6069, The Mining of Gilsonite in Utah, issued May 1, 1928.

In 1928 five producers mined gilsonite in northeastern Utah—the American Asphalt Association, of St. Louis, Mo., operating near Dragon, Uintah County; the Diamond Gilsonite Co., operating near Fort Duchesne, Uintah County; the Gilson Asphaltum Co., of Philadelphia, operating near Watson, Uintah County; the Raven Mining Co., of Chicago, operating in Duchesne and Uintah Counties, near Roosevelt; and the Utah Gilsonite Co., of St. Louis, operating at Watson, Uintah County. Their total sales increased from 42,580 short tons, valued at $876,820, or about $20.59 a ton, to 47,023 tons, valued at $1,037,679, or about $22.07 a ton. This increase in the value of the gilsonite sold is more apparent than real, as one important producer reported the value of sales delivered at a shipping point nearly 150 miles from the mine and at consuming centers in central and eastern United States. Values quoted at the mine ranged from 1 to 24 per cent lower in 1928 than in 1927.

The higher grades of gilsonite are made into varnish, paint, electrical insulation, and inks for rotogravure sections of newspapers. The intermediate grade is used for such articles as telephone mouthpieces, switch handles, and knobs and buttons of various kinds. The poorer grade is used to saturate felt in the manufacture of roofing and floor coverings.

OZOKERITE

Ozokerite, a mineral wax similar in chemical and physical properties to paraffin produced from petroleum, is mined commercially in northeastern Utah on the western margin of the Uinta Basin. It fills veins cutting the Wasatch formation of lower Eocene age.

Sales of ozokerite increased from 80 short tons valued at $32,000 in 1927 to 150 tons valued at $60,000 in 1928. At the same time imports of mineral wax, which averaged 3,398 short tons a year from 1921 to 1927, increased from 3,800 tons valued at $579,118 in 1927 to 5,451 tons valued at $594,416 in 1928. In recent years three-fourths of these imports have come from Germany. They include not only crude ozokerite but also refined ozokerite (ceresine) and montan wax distilled from lignite.

Ozokerite and other mineral waxes imported for consumption in the United States, 1919–1928

Year	Pounds	Value	Year	Pounds	Value
1919	3, 748, 080	$454, 840	1924	3, 113, 819	$207, 833
1920	4, 272, 341	499, 758	1925	6, 175, 184	361, 767
1921	8, 548, 542	546, 054	1926	8, 287, 397	479, 957
1922	8, 989, 972	371, 161	1927	7, 599, 708	579, 118
1923	4, 856, 357	213, 407	1928	10, 901, 389	594, 416

WURTZILITE (ELATERITE)

Wurtzilite, known popularly as elaterite, is a black asphaltic pyrobitumen somewhat more elastic than other native bitumens and capable of being cut with a knife like horn or whalebone. It is found in only one locality in the United States, in Uintah County, Utah, about 50 miles southwest of Fort Duchesne. More than 30 veins, varying in width from 1 inch to 3 feet and in length from several hundred feet to about 3 miles, cut the Green River formation of the middle Eocene in the western part of the Uinta Basin.

Sales of wurtzilite fell from 280 short tons valued at $24,750 in 1927 to 190 tons valued at $17,100 in 1928. Lack of transportation facilities other than motor trucks and a long haul of 95 miles to the nearest railroad have hampered the development of this industry.

ICHTHYOL

Ichthyol is a chemical or pharmaceutical product rather than a mineral. It was made originally in Germany from crude oil distilled from a Triassic bituminous shale mined at Seefeld in the Austrian Tyrol. The crude shale oil was then sulphonated and the resultant ichthyol-sulphonic acid neutralized with concentrated ammonia water. The final product may be described chemically as ammonium ichthyol-sulphonate.

Shortly after the outbreak of the World War it became difficult or even impossible to obtain shipments of ichthyol from Germany. The production of substitutes from domestic raw materials was begun in Switzerland, Italy, Japan, and the United States. In 1920 the development of an asphaltic limestone was started near Burnet, Tex.

Oil distilled from the limestone was shipped to a chemical plant at Durant, Rockland County, N. Y., where a pharmaceutical product was prepared.

After two years of operation the mine and plant were sold; no ichthyol has been made in the United States from asphaltic limestone since 1922.

Imports of ichthyol and ichthyol substitutes decreased from 48,199 pounds valued at $58,821 in 1927 to 42,610 pounds valued at $60,321 in 1928.

PRODUCERS

Production of native asphalts and related bitumens was reported in this country in 1928 by the following operators:

Alabama Rock Asphalt (Inc.), 310 Pioneer Building, Birmingham, Ala.
American Asphalt Association, 919 Wainwright Building, St. Louis, Mo.
Bitumen Mines Operation, 701 Post Street, San Francisco, Calif.
Colbert Limerock Asphalt Co., Cherokee, Ala.
Crown Rock Asphalt Co., Blymyer Building, Cincinnati, Ohio.
Diamond Gilsonite Co., Fort Duchesne, Utah.
Gilson Asphaltum Co., 1600 Arch Street, Philadelphia, Pa.
Kentucky Rock Asphalt Co., 711–718 Marion E. Taylor Building, Louisville, Ky.
National Bitumen Products Corporation, 835 Howard Street, San Francisco, Calif.
Natural Rock Asphalt Corporation, Natural Rock, Ky.
Ohio Valley Rock Asphalt Co., Starks Building, Louisville, Ky.
Ozokerite Mining Co. (Inc.), Soldier Summit, Utah.
Raven Mining Co. of Utah, 140 South Dearborn Street, Chicago, Ill.
D. A. Sattler, Box 233, Carpinteria, Calif.
Texas Rock Asphalt Co., 822 Frost National Bank, San Antonio, Tex.
United Rock Asphalt Co., 1610 Intersouthern Building, Louisville, Ky.
Utah Rock Asphalt Corporation, 441 Thatcher Building, Pueblo, Colo.
Utah Gilsonite Co., Wainwright Building, St. Louis, Mo.
Uvalde Rock Asphalt Co., P. O. Box 958, San Antonio, Tex.
Western Paving Co., 1519 Petroleum Building, Oklahoma City, Okla.
White's Uvalde Mines, P. O. Box 902, San Antonio, Tex.

MANUFACTURED OR PETROLEUM ASPHALT

GENERAL STATEMENT

A 6.2 per cent reduction in the sales of paving asphalt led to a 2.2 per cent decrease in the total sales of solid, semisolid, and liquid asphalt (excluding road oil) prepared from petroleum. This decrease was from 3,654,340 short tons valued at $51,661,570 in 1927 to 3,572,274 tons valued at $46,268,546 in 1928. On the other hand, sales of road oil, as reported by refineries producing asphalt, increased 45.8 per cent in quantity from 297,110 short tons, or about 1,818,300 barrels, in 1927 to 433,255 tons, or 2,651,500 barrels in 1928, and 22.8 per cent in value—from $3,129,520 in 1927 to $3,844,439 in 1928. A good market for prepared roofing and floor coverings was reflected in enlarged sales of asphalt for roofing and waterproofing. More asphalt was sold for miscellaneous uses, which included battery-sealing compounds and binders for briquetting and other purposes, as well as paints, varnishes, enamels, coatings, and insulating and preservative compounds.

Prices of nearly all grades were 9 to 10 per cent lower in 1928 than in 1927. Road oil, however, was 15.8 per cent less per ton. The average sales value per ton of all asphaltic products, including road oil, fell off 9.8 per cent, from $13.87 in 1927 to $12.51 in 1928.

Imports of asphalt, consisting almost entirely of natural lake asphalts of a high degree of purity from Venezuela and Trinidad, were 24 per cent less in quantity and 25 per cent less in value. As these high-grade natural asphalts are refined and sold by petroleum refiners and are employed in connection with or come into direct competition with petroleum asphalts in many of their uses they are discussed in the present chapter in connection with petroleum asphalts rather than with natural rock asphalts, which contain a comparatively low percentage of bitumen and are used almost entirely for paving roads and streets.

The domestic demand for petroleum and lake asphalt decreased 11 per cent to a little less than the consumption in 1926. Exports of petroleum asphalt were 28 per cent larger in 1928 than in 1927, but more than 47 per cent of the 1928 total was shipped out in the first four months of the year, and nearly 67 per cent during the first six months.

REFINERY PRODUCTION

For the first time since 1921 refinery production of asphalt (exclusive of road oil) manufactured from petroleum decreased, dropping from 3,817,539 short tons in 1927 to 3,548,527 tons in 1928. Substantial gains in the production of asphalt in the refineries of the Middle West and of California did not suffice to offset the lowered production of the Atlantic coast and Gulf coast refineries, which furnished 69.4 per cent of the national output.

Asphalt (exclusive of road oil) produced at refineries in the United States, 1926–1928, by districts, in short tons[1]

District	1926	1927	1928
East coast	1, 520, 322	1, 846, 282	1, 691, 653
Appalachian	5, 114	6, 471	7, 981
Indiana-Illinois	264, 418	402, 321	418, 681
Oklahoma-Kansas-Missouri	16, 025	5, 370	9, 665
Texas:			
Gulf coast	275, 859	373, 933	207, 700
Rest of State	2	------------	728
Total Texas	275, 861	373, 933	208, 428
Louisiana-Arkansas:			
Louisiana Gulf coast	605, 418	602, 066	562, 300
Northern Louisiana and Arkansas	21, 551	19, 566	15, 443
Total Louisiana and Arkansas	626, 969	621, 632	577, 743
Rocky Mountain	37, 021	26, 221	14, 296
California	495, 367	535, 309	620, 080
Grand total	3, 241, 097	3, 817, 539	3, 548, 527

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[1] These figures, compiled directly from returns made by petroleum refineries producing asphalt, differ from the statistics of asphalt production published on page 74 of the Asphalt chapter of Mineral Resources of the United States in 1927, and on pages 40 and 41 of Petroleum Refinery Statistics, 1927 (Bureau of Mines Bulletin 297) chiefly because of the differences in classification. In the monthly and annual refinery statements some of the more liquid products are listed under "All other finished products."

SOURCE OF RAW MATERIAL

Petroleum asphalt is a residual product obtained in the refining of petroleum after the gasoline, kerosene, gas oil, lubricants, and other products have been distilled off. Of the total refinery production in 1928, 2,156,172 short tons, or 60.8 per cent, was manufactured from crude oil imported from Venezuela, Mexico, and Colombia. Nearly 93 per cent of the asphalt manufactured in the east coast refineries and over 76 per cent of the asphalt manufactured in the Gulf coast refineries of Louisiana and Texas were derived from foreign petroleum. These two refining districts manufacture all the asphalt prepared from foreign petroleum. Nearly one-half of the 1,392,355 short tons of asphalt obtained from domestic petroleum was manufactured in California, from California crude oil, and nearly one-third in Indiana and Illinois, chiefly from Mid-Continent crude oil.

. Although a recovery of asphalt varying from 25 to 60 per cent of the total crude run is possible from crude petroleums imported from Colombia, Venezuela, and Mexico, not all importing refineries make asphalt. Consequently, the average recovery of asphalt obtained from these crudes in recent years has varied from 19 to 32 per cent. In like manner, although a recovery of asphalt ranging from 2 or 3 to 20 or even 25 per cent is possible from certain domestic crudes, the average recovery in recent years has been barely 1⅓ per cent of all grades of domestic crude oils run to stills. There is no fixed relation from month to month or year to year between the quantity of foreign or of domestic petroleum run to stills and the amount of asphalt manufactured from it. Market conditions and prices determine in large measure whether a greater or a smaller proportion of fuel oil or of asphalt shall be made from the crude, after the gasoline and other light fractions have been distilled off.

Foreign crude petroleum run to stills at refineries in the United States, 1927 and 1928, in thousands of barrels

	January	February	March	April	May	June	July	August	September	October	November	December	Total
1927													
East coast	2,499	2,326	2,968	2,823	2,776	3,020	3,222	3,888	3,817	4,670	4,756	5,282	42,047
Texas Gulf coast	120	58	85	100	109	96	51	24	23	43	21	84	814
Louisiana Gulf coast	1,032	765	734	466	549	522	562	591	549	525	456	494	7,245
	3,651	3,149	3,787	3,389	3,434	3,638	3,835	4,503	4,389	5,238	5,233	5,860	50,106
1928													
East coast	4,648	4,764	5,284	5,355	5,937	6,686	6,572	5,901	6,078	5,940	5,757	5,864	68,786
Texas Gulf coast	53	67	56	70	117	70	94	97	87	297	129	109	1,246
Louisiana Gulf coast	321	457	392	414	560	490	503	992	944	1,161	670	648	7,552
	5,022	5,288	5,732	5,839	6,614	7,246	7,169	6,990	7,109	7,398	6,556	6,621	77,584

SEASONAL VARIATION IN MANUFACTURE

Since nearly half of the output of manufactured asphalt is sold for paving and the amount of paving done depends largely on weather conditions the production of asphalt varies with the seasons. A survey of the monthly shipments of petroleum asphalt from 1924 to 1928 shows that three-fifths of the total shipments of the year are made in the six months from May 1 to October 31, when activity in road building is highest. The peak of shipments is attained in August, when 10.5 per cent of the year's shipments are made. Conversely, the smallest shipments are made in January (6 per cent) and in February (5 per cent), when snow, ice, prolonged cold, and rain prevent road building over the most thickly populated part of the United States. On the other hand, the demand for roofing asphalt, which amounts to about one-fourth of the total sales, is distributed over the year fairly evenly and tends to diminish somewhat the seasonal variation in the total sales of asphalt.

The production of petroleum asphalt in the refineries is closely adjusted to the monthly demand, as can be seen from the following table of the percentages of asphalt produced each month, derived from the returns of the monthly canvass of refineries for statistics of refining.

Per cent of asphalt produced in petroleum refineries in the United States, 1924–1928, by months

Month	1924	1925	1926	1927	1928	5-year average
January	5.8	6.0	5.6	5.6	6.1	5.8
February	6.5	4.4	5.2	5.1	6.3	5.5
March	7.4	6.5	7.2	6.5	8.0	7.1
April	6.4	7.8	6.8	8.0	8.3	7.5
May	8.0	9.9	8.5	9.3	10.0	9.1
June	8.7	9.9	10.3	10.1	10.0	9.8
July	9.6	10.2	9.6	9.8	10.0	9.9
August	10.6	10.8	10.5	9.9	9.6	10.3
September	9.8	9.9	10.5	9.8	9.3	9.9
October	10.6	10.6	11.1	9.7	9.7	10.3
November	9.1	8.2	7.4	8.5	7.4	8.1
December	7.5	5.8	7.3	7.7	5.3	6.7
Total	100.0	100.0	100.0	100.0	100.0	100.0

GEOGRAPHIC LOCATION OF MANUFACTURE

The manufacture of asphalt from petroleum tends to be concentrated near seaports or near the principal consuming and distributing centers of the interior. It is evident that the available supply of raw material has less influence on the location of the refining plant than has the local demand for the finished product and the facilities for distributing it over a wider area. Although the Gulf coast ports are nearer by ordinary sailing routes to crude oil sources in Venezuela, Colombia, and Mexico than are the Atlantic ports, only 27 per cent of the asphalt manufactured from foreign petroleum in 1928 was made in the Gulf coast refineries near New Orleans, Baton Rouge, and Port Arthur, Tex., whereas 66 per cent was made in Atlantic coast refineries near New York, Philadelphia, and Baltimore. The Atlantic coast refineries have the advantage of proximity to important industrial consumers and areas of large population near these seaports and of ample railroad connections with such large asphalt-consuming States as Massachusetts, New York, New Jersey, Pennsylvania, Ohio, and even Indiana and Illinois. This area of large consumption is also served from the west by refineries near Chicago, St. Louis, and Kansas City, all large cities and important railroad centers. These refineries, operating chiefly on Mid-Continent crude, manufactured 42 per cent of all asphalt made in 1928 east of California from domestic crudes. The Gulf coast refineries near New Orleans, Baton Rouge, and Port Arthur, though nearer to the sources of imported crude petroleum, have smaller populations and fewer industrial consumers of asphalt in their immediate vicinity and a much smaller demand for asphalt in Texas, Oklahoma, Missouri, Arkansas, Louisiana, Mississippi, Tennessee, and Kentucky, which constitute their nearest available market. In like manner the refineries that manufacture asphalt from California crude are concentrated near Los Angeles and San Francisco, the two leading seaports, railroad shipping points, and distributing centers of California.

EAST COAST DISTRICT

Nearly half of the national production of petroleum asphalt is manufactured in the refineries of the east coast district, chiefly in the vicinity of New York, Philadelphia, and Baltimore. From 45 per cent in 1925 the share furnished by the east coast refineries has grown to about 48 per cent of the national production in 1928. Ninety-two to ninety-six per cent of the asphalt produced in east coast refineries is manufactured from foreign petroleum, imported chiefly from Venezuela and Mexico, and the remainder from Texas, Louisiana, and Mid-Continent crude oils shipped principally from Gulf coast ports in tank steamers.

In the east coast district production diminished 8.4 per cent, sales fell off 5.2 per cent, and stocks increased 3 per cent in 1928, as compared with 1927. This coincided with a 4.8 per cent decrease in consumption of asphalt in the area lying north of the Potomac and Ohio Rivers and east of the Mississippi and Illinois Rivers, where the greater part of the asphalt manufactured near New York, Philadelphia, and Baltimore is sold.

GULF COAST DISTRICT

Second only to the east coast district in the production of petroleum asphalt is the Gulf coast district of Louisiana and Texas. Refineries located chiefly near New Orleans and Baton Rouge, La., and near Port Arthur, Tex., produced 21.7 per cent of the national output of manufactured asphalt in 1928. Since 1923, when the Gulf coast furnished 31 per cent of the national production, the output especially of the refineries in coastal Texas has declined both in quantity and in relative importance. This decline has coincided with the marked general decrease in the quantity and the proportion of foreign crude refined in coastal Texas. From 1925 to 1927 about 84 per cent of the Gulf coast asphalt was manufactured from foreign petroleum, imported chiefly from Mexico, and the remaining 16 per cent from naphthene-base crude oils produced in near-by Texas and Louisiana. In 1928, however, with the flush production in western

Texas, 23.7 per cent of the asphalt produced in coastal Texas and Louisiana was made from domestic petroleum and only 76.3 per cent from foreign crude.

In the Gulf coast district production decreased 21.1 per cent, sales 20.4 per cent, and stocks 3.3 per cent in 1928 as compared with 1927. The greater part of the asphalt production of the Gulf coast refineries is shipped east of the Mississippi River and much of it north of the Ohio River.

INDIANA-ILLINOIS DISTRICT

An increasingly important part in the national production of asphalt is played by the refineries of Illinois and Indiana, of which the largest are located in the vicinity of Chicago and East St. Louis. From 5.4 per cent in 1924 their share in the total production has grown to 11.8 per cent in 1928. These refineries treat oil obtained by pipe line chiefly from the Mid-Continent and near-by Illinois and Indiana fields. They market the greater part of their asphalt in central United States, both east and west of the Mississippi River.

CALIFORNIA DISTRICT

In California two groups of refineries, centering about San Francisco and Los Angeles, have manufactured 14 to 18 per cent of the total output of manufactured asphalt in the United States from California crude. In 1928 their share was 17.5 per cent. By far the greater part of their production was marketed in the three Pacific States, especially in California.

REFINERY STOCKS

Because the manufacture of petroleum asphalt is rather closely adjusted to sales large stocks are not carried. An average of stocks carried on the last day of each month from January 31, 1918, to December 31, 1926, shows that they are largest from March (26.4 days' supply) to July (25.2 days' supply), attaining their peak in May with 27.6 days' supply, and are lowest in October, with 21.6 days' supply. They amounted on December 31, 1925, to 22.0 days' supply of the total demand, domestic and foreign; on December 31, 1926, to 24.4 days' supply; on December 31, 1927, to 23.8 days' supply; and on December 31, 1928, to 26.2 days' supply.

Asphalt in stock at refineries in the United States at end of each month, 1927 and 1928, by districts, in thousands of short tons

District	January	February	March	April	May	June	July	August	September	October	November	December
1927												
East coast	79.9	90.8	95.8	88.6	92.1	100.3	87.8	75.4	61.6	75.5	77.9	89.5
Appalachian				.4	.5	1.9	2.5	2.5	2.3	1.9	.9	.5
Indiana, Illinois, etc	40.2	41.3	40.6	34.3	33.6	31.3	27.3	24.4	23.2	21.7	20.8	23.9
Oklahoma, Kansas, etc	.9	1.2	1.4	1.7	1.5	1.5	1.4	1.7	1.4	1.4	1.7	1.6
Texas: Gulf coast	9.1	10.1	10.0	9.3	7.7	8.1	8.4	8.3	6.4	8.5	8.3	10.9
Louisiana and Arkansas:												
Louisiana Gulf coast	32.8	32.0	29.3	27.0	22.4	22.5	22.0	18.3	21.0	21.4	25.6	32.3
Northern Louisiana and Arkansas	1.3	1.7	1.7	.2	.4	.4	.1	.2	.3	.1	.5	.4
Total Louisiana and Arkansas	34.1	33.7	31.0	27.2	22.8	22.9	22.1	18.5	21.3	21.5	26.1	32.7
Rocky Mountain	8.0	7.5	7.1	7.3	9.0	10.0	10.3	10.0	10.7	9.0	9.4	9.4
California[1]	43.2	49.9	49.4	50.7	55.3	56.4	54.3	51.4	50.2	49.9	51.1	52.3
Grand total[1]	215.4	234.5	235.3	219.5	222.5	232.4	214.1	192.2	177.1	189.4	196.2	220.8
1928												
East coast	88.0	97.6	123.8	128.6	124.7	133.7	111.5	98.2	89.9	78.3	93.9	92.2
Appalachian	.2					.5	.7	.8	.8	.4	.4	.4
Indiana, Illinois, etc	28.8	28.5	34.6	41.2	35.1	37.1	39.3	34.0	26.7	36.9	36.3	46.1
Oklahoma, Kansas, etc	1.4	1.7	1.7	1.9	1.8	2.2	1.7	3.1	3.5	4.0	1.7	1.5
Texas: Gulf coast	11.1	9.6	9.8	7.6	8.2	7.9	8.2	7.0	7.4	8.0	7.1	10.6
Louisiana and Arkansas:												
Louisiana Gulf coast	26.9	34.8	34.0	26.5	27.0	22.6	25.3	24.9	17.8	23.0	30.1	31.1
Northern Louisiana and Arkansas	.3	.3	.3	.2	.3	.2	.1	.1	.2	.3	.1	.4
Total Louisiana and Arkansas	27.2	35.1	34.3	26.7	27.3	22.8	25.4	25.0	18.0	23.3	30.2	31.5
Rocky Mountain	9.5	9.2	9.1	8.6	8.5	8.4	8.5	8.4	8.0	8.1	8.3	8.1
California	52.8	52.2	46.5	59.0	56.5	57.9	51.8	48.9	48.6	50.9	50.0	45.0
Grand total	219.0	233.9	259.8	273.6	262.1	270.5	247.1	225.4	202.9	209.9	227.9	235.4

[1] Revised figures.

SALES BY USES

Two-fifths, on an average, of all asphaltic products marketed—solid, semisolid, and liquid—comprise paving asphalt of less than 200 penetration. Roofing and waterproofing asphalt constitute more than one-fourth of the total. Road oil, as reported by asphalt-producing refineries, forms one-tenth of the whole; if the road oil sold by refineries that do not manufacture asphalt is taken into consideration it constitutes nearly one-fifth. Roofing and waterproofing flux amount to about 7 per cent, paving flux to about 4 per cent, and miscellaneous solid and semisolid products to 5 per cent.

PAVING

For the first time since 1921 sales of solid and semisolid asphalt for paving decreased, from 1,652,190 short tons valued at $25,177,360 in 1927 to 1,549,354 tons valued at $21,271,309 in 1928, decreases of 6.2 per cent in quantity and 15.5 in value. The average sales value per short ton decreased from $15.24 in 1927 to $13.73 in 1928, or 9.9 per cent.

Asphalt and asphaltic material sold at petroleum refineries in the United States, 1927 and 1928, by varieties

[Value f. o. b. refinery]

	From domestic petroleum		From foreign petroleum		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1927						
Solid and semisolid products of less than 200 penetration:[1]						
Asphalt—						
Paving	556, 280	$8, 199, 100	1, 095, 910	$16, 978, 260	1, 652, 190	$25, 177, 360
Roofing and waterproofing	457, 460	5, 471, 350	561, 190	8, 407, 880	1, 018, 650	13, 879, 230
Mineral rubber	4, 840	86, 410	16, 070	244, 520	20, 910	330, 930
Other solid and semisolid products	78, 180	928, 810	91, 590	1, 372, 530	169, 770	2, 301, 340
	1, 096, 760	14, 685, 670	1, 764, 760	27, 003, 190	2, 861, 520	41, 688, 860
Semisolid and liquid products of more than 200 penetration:[1]						
Flux—						
Paving	22, 470	311, 810	207, 330	2, 757, 010	229, 800	3, 068, 820
Roofing and waterproofing	100, 350	1, 151, 680	183, 560	2, 398, 560	283, 910	3, 550, 240
Other	860	14, 420	190, 350	2, 461, 770	191, 210	2, 476, 190
Other liquid products	62, 140	506, 970	25, 760	370, 490	87, 900	877, 460
	185, 820	1, 984, 880	607, 000	7, 987, 830	792, 820	9, 972, 710
Road oil	242, 840	2, 348, 600	54, 270	780, 920	297, 110	3, 129, 520
Grand total	1, 525, 420	19, 019, 150	2, 426, 030	35, 771, 940	[2] 3, 951, 450	54, 791, 090
1928						
Solid and semisolid products of less than 200 penetration:[1]						
Asphalt—						
Paving	636, 533	8, 867, 658	912, 821	12, 403, 651	1, 549, 354	21, 271, 309
Roofing	358, 185	4, 371, 105	587, 388	7, 644, 364	945, 573	12, 015, 469
Waterproofing	127, 417	1, 382, 847	208, 952	2, 418, 379	336, 369	3, 801, 226
Mineral rubber	3, 812	72, 897	17, 862	233, 529	21, 674	306, 426
Other solid and semisolid products	75, 864	864, 050	98, 887	1, 258, 628	174, 751	2, 122, 678
	1, 201, 811	15, 558, 557	1, 825, 910	23, 958, 551	3, 027, 721	39, 517, 108

Footnotes at end of table.

Asphalt and asphaltic material sold at petroleum refineries in the United States, 1927 and 1928, by varieties—Continued

	From domestic petroleum		From foreign petroleum		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1928—Continued						
Semisolid and liquid products of more than 200 penetration:[1]						
Flux—						
Paving	28, 320	$404, 535	98, 857	$1, 740, 128	127, 177	$2, 144, 663
Roofing	94, 609	1, 079, 293	172, 082	1, 937, 792	266, 691	3, 017, 085
Waterproofing	245	10, 236	------------	------------	245	10, 236
Other	------------	------------	17, 312	217, 572	17, 312	217, 572
Other liquid products	72, 551	582, 362	60, 577	779, 520	133, 128	1, 361, 882
	195, 725	2, 076, 426	348, 828	4, 675, 012	544, 553	6, 751, 438
Road oil	343, 856	2, 790, 388	89, 399	1, 054, 051	433, 255	3, 844, 439
Grand total	1, 741, 392	20, 425, 371	2, 264, 137	29, 687, 614	[2] 4, 005, 529	50, 112, 985

[1] Definitions:

Paving asphalt.—Refined native asphalt and asphaltic cement, fluxed and unfluxed, produced for direct use in the construction of sheet asphalt, asphaltic concrete, asphalt macadam, and asphalt block pavements, and also for use as joint filler in brick, block, and monolithic pavements.

Roofing and waterproofing asphalt.—Asphalt and asphaltic cement used in saturating, coating, and cementing felt or other fabric and in the manufacture of asphalt shingles.

Mineral rubber.—Asphalt and asphaltic cement used by the rubber industry.

Other solid and semisolid products.—Asphalt and asphaltic cement used as dips and in the manufacture of insulating material, acid-resisting compounds, putty, mastic, and briquets and not included in the preceding definitions.

Flux.—Liquid asphaltic material used in softening native asphalt or solid petroleum asphalt for paving, roofing, waterproofing, and other purposes.

Other liquid products.—Petroleum asphalt used in the manufacture of saturant, paint, varnish, or other coating, exclusive of fuel oil and not included in the preceding definitions.

Road oil.—Residual asphaltic oil used for surface treatment.

[2] The difference between this total and that reported in the table on p. 399 is due partly to the differences in the classification of liquid products (for example, road oil is included in the total sales on this page, but not in the total production on p. 399), and partly to the fact that the figures in this table represent sales and those recorded in the refinery table are for production. Moreover, the figure of 433,255 short tons of road oil sold in 1928 and the grand total of 4,005,529 tons of all asphaltic products sold do not include 416,745 tons of road oil sold in 1928 by petroleum refineries that did not produce asphalt.

Similarly, sales of paving flux decreased from 229,800 short tons valued at $3,068,820 in 1927 to 127,177 tons valued at $2,144,663 in 1928, or 44.7 per cent in quantity but only 30.1 per cent in value. The average sales value increased 26.3 per cent, from $13.35 per short ton in 1927 to $16.86 in 1928.

On the other hand, on the same basis of returns, sales of road oil increased from 297,110 short tons or about 1,818,300 barrels valued at $3,129,520 in 1927 to 433,255 tons or 2,651,500 barrels valued at $3,844,439 in 1928, representing an increase of 45.8 per cent in quantity but of only 22.8 per cent in value. The unit value of road oil decreased from $10.53 per short ton or $1.72 per barrel in 1927 to $8.87 per ton or $1.45 per barrel in 1928.

The foregoing figures do not include 416,745 short tons or 2,312,500 barrels of road oil sold in 1928 by oil companies not reporting any production of asphaltic materials, but reported in the monthly canvass of refineries under "All other finished products." Accordingly, the true total road oil sold in 1928 would be 850,000 short tons or 4,964,000 barrels. Comparable figures for 1927 and 1926 are not available.

Road oil produced at petroleum refineries in the United States in 1928, by districts

District	Thousands of barrels	Equivalent in short tons
East coast	1,116	191,096
Appalachian	19	3,253
Indiana, Illinois, Kentucky, etc.	1,644	281,507
Oklahoma, Kansas, and Missouri	297	50,856
Texas[1]	3	514
Louisiana and Arkansas:		
Louisiana Gulf coast	549	94,007
Northern Louisiana and Arkansas	74	12,671
Total Louisiana and Arkansas	623	106,678
Rocky Mountain	41	7,021
California	1,221	209,075
Grand total	4,964	850,000

[1] None produced in Texas Gulf coast district.

Since fully 45 per cent of asphaltic substances other than road oil, or about 55 per cent of all bituminous substances including road oil, is used for paving, much interest centers about reported activity in street paving and road building. Although the figures at hand for rural roads are fairly complete, the available figures for city street paving are not representative enough to warrant any generalizations.

According to figures compiled by the Bureau of Public Roads, at the end of 1927 there were in the United States, under State, county, and local administration combined, 91,936.1 miles of rural roads of bituminous macadam and higher types of construction, suitable for moderate to heavy motor traffic. Of this mileage 29.4 per cent was surfaced with bituminous macadam by penetration, 9.5 per cent with bituminous concrete, 3 per cent with sheet asphalt, and 0.4 per cent with asphalt block, or 42.3 per cent altogether with asphaltic types of pavement. Of the new mileage of rural roads, State, county, and local combined, constructed from 1923 to 1926, inclusive, 36.44 per cent was surfaced with bituminous types of paving as compared with 34.6 per cent in 1927 and 38.3 per cent in 1928.

Additional light may be shed on present tendencies in rural road building by the statistics of Federal-aid highway construction published by the Bureau of Public Roads. Although the Federal-aid roads actually completed to date total only about 8 per cent of the entire mileage of surfaced rural roads in the United States, in some ways they may be regarded as indicative of trends in rural-road construction. They are distributed among the 48 States in proportion to population, area, and mileage of existing highways and constitute portions of the most traveled routes.

To December 31, 1928, a total of 27,010.6 miles of rural roads of bituminous macadam and higher types of construction had been built or improved with the aid of Federal funds under the supervision of the Bureau of Public Roads. Of this total mileage bituminous macadam constituted 17.1 per cent and bituminous concrete 8.1 per cent.

In the three fiscal years 1923, 1924, and 1925 bituminous macadam constituted 22 per cent and bituminous concrete 7 per cent of the new mileage of Federal-aid roads of bituminous macadam and higher types of construction. During the year ended June 30, 1927, the proportion surfaced with bituminous macadam had diminished to

17.4 per cent and of bituminous concrete to 6 per cent. In the fiscal year ended June 30, 1928, the share of bituminous macadam was only 14.6 per cent and of bituminous concrete 4.3 per cent. In the calendar year ended December 31, 1928, bituminous macadam was used to pave 13.3 per cent and bituminous concrete 6.4 per cent of the total mileage of Federal-aid roads completed.

Statistics of city paving for 1928 at present available do not afford an adequate basis for comparison with previous years and are not truly representative of urban tendencies in street paving.

ROOFING AND WATERPROOFING

Sales of solid and semisolid asphalt for roofing and waterproofing continued the upward trend manifested since 1921. They increased 25.8 per cent in quantity (from 1,018,650 short tons in 1927 to 1,281,942 tons in 1928) and 14 per cent in value (from $13,879,230 in 1927 to $15,816,695 in 1928). The average sales value per short ton decreased 9.5 per cent—from $13.63 in 1927 to $12.34 in 1928. On the basis of partial returns it is estimated that nearly three-fourths of the total, or 945,573 short tons, valued at $12,015,469, consisted of roofing asphalt.

Sales of roofing and waterproofing flux declined from 283,910 short tons valued at $3,550,240 in 1927 to 266,936 tons valued at $3,027,321 in 1928, representing a decline of about 6 per cent in quantity and of about 15 per cent in value. The unit value per short ton dropped 9 per cent, from $12.50 in 1927 to $11.34 in 1928.

The demand for roofing and waterproofing asphalt increased. About 35,979,000 squares[2] of prepared roofing were shipped from factories in 1928, according to the Survey of Current Business published by the Bureau of the Census in cooperation with the Bureau of Foreign and Domestic Commerce and the Bureau of Standards. The demand for prepared roofing is remarkably uniform throughout the year. Although the monthly shipments from factories for the five years ended December 31, 1928, averaged as little as 5.8 per cent of the annual total in January and 6.2 per cent in February, and rose as high as 9.6 per cent in September and 10.4 per cent in October, for two-thirds of the year they ranged between 8 and 9 per cent.

On the other hand, the manufacture of asphalted-felt-base floor coverings reported by the Bureau of the Census increased from 71,076,078 square yards in 1923 to 77,888,999 square yards in 1925 and 111,793,136 square yards in 1927. Similar figures for 1928 are not available.

MISCELLANEOUS USES

Sales of solid and semisolid asphalt for miscellaneous uses increased from 169,770 short tons valued at $2,301,340 in 1927 to 174,751 tons valued at $2,122,678 in 1928. The average sales value per short ton decreased 10.4 per cent—from $13.56 in 1927 to $12.15 in 1928.

Sales of miscellaneous liquid asphalt products increased from 87,900 short tons valued at $877,460 in 1927 to 133,128 tons valued at $1,361,882 in 1928. The average sales value per short ton increased 2.5 per cent—from $9.98 in 1927 to $10.23 in 1928.

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[2] A roof square is equivalent to 100 square feet of covering as measured on the roof.

DISTRIBUTION BY RAIL

Nine-tenths of the petroleum asphalt consumed in the United States is distributed by rail. Shipments of asphalt originating on Class I railroads totaled 2,530,848 short tons in 1925, 3,100,954 tons in 1926, 3,169,896 tons in 1927, and 2,899,326 tons in 1928. Asphalt terminated by Class I railroads in 1928 amounted to 2,987,075 tons.

By far the greater part of the asphalt transported by rail is shipped in specially equipped tank cars furnished by the shipper, having an average capacity of 10,000 gallons, or 40 short tons. The railroad pays a specified rental for these cars, based on the mileage traversed while loaded and while empty. The asphalt is loaded into the cars while hot and allowed to cool and harden. To discharge the lading the asphalt is heated by steam coils with which the tank cars are equipped. Asphalt is not considered dangerous to transport, and claims for loss or damage are negligible. Much asphalt also is shipped in steel drums that contain an average of 425 pounds of asphalt.

In the actual distribution of asphalt to the points of consumption it is exchanged between railroad systems to a bewildering extent, as can be seen from the statistics of the total tonnage of asphalt carried by Class I railroads in the United States, which amounted to 5,900,093 short tons in 1925, 6,836,945 tons in 1926, 7,042,765 tons in 1927, and 6,414,948 tons in 1928. Needless to say, these figures include many duplications of the same shipments, transported over two or more railroad systems.

Asphalt shipments originating on Class I railroads in the United States, 1926–1928, in short tons [1]

	1926	1927	1928
Eastern district:			
Baltimore & Ohio	190,057	202,640	227,349
Central of New Jersey	295,048	326,773	359,019
Elgin, Joliet & Eastern	63,778	68,966	89,958
Lehigh Valley	124,298	122,753	118,781
New York Central	17,030	20,801	34,638
New York, New Haven & Hartford	119,004	138,604	147,478
Pennsylvania	373,443	310,899	325,843
Other railroads	211,142	207,486	294,963
Total Eastern district	1,393,800	1,398,922	1,598,029
Southern district:			
Atlantic Coast Line	100,037	82,385	64,744
Illinois Central	74,027	119,302	63,570
Louisville & Nashville	174,637	199,299	79,843
Seaboard Air Line	58,349	52,296	26.384
Southern	64,223	53,919	44,867
Yazoo & Mississippi Valley	358,654	359,131	358,117
Other railroads	65,009	58,011	66,326
Total Southern district	894,936	924,343	703,851
Western district:			
Atchison, Topeka & Santa Fe	68,456	49,594	48,104
Chicago & Alton	42,027	51,296	75,552
Chicago, Burlington & Quincy	48,068	41,131	29,933
Chicago & Northwestern	49,529	52,757	6,680
Gulf, Colorado & Santa Fe	31,312	28,108	819
Louisiana Railway & Navigation Co	61,614	37,105	67,837
San Antonio, Uvalde & Gulf	99,280	219,680	41,788
Southern Pacific (Pacific lines)	152,696	137,356	104,392
Southern Pacific (lines in Texas and Louisiana)	100,871	39,634	5,287
Texarkana & Fort Smith	106,650	137,671	136,368
Other railroads	51,715	52,299	80,686
Total Western district	812,218	846,631	597,446
Total United States	3,100,954	3,169,896	2,899,32

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[1] Freight Commodity Statistics, Interstate Commerce Commission. In the statistics for 1928 the material carried was designated as "asphalt (natural, by-product, or petroleum)"; in those for 1926 and 1927, merely as "asphaltum."

Asphalt terminated by Class I railroads in the United States in 1928, in short tons[1]

	Originating on carrier's lines	Received from connecting carriers	Total
Eastern district:			
Baltimore & Ohio	89, 029	140, 683	229, 712
Central of New Jersey	53, 429	5, 357	58, 786
Elgin, Joliet & Eastern	14, 291	74, 479	88, 770
Erie	945	127, 124	128, 069
Lehigh Valley	40, 698	29, 535	70, 233
Michigan Central	8, 256	49, 453	57, 709
New York Central	20, 607	156, 570	177, 177
New York, New Haven & Hartford	130, 201	31, 158	161, 359
Pennsylvania	235, 228	110, 110	345, 338
Other railroads	64, 320	391, 732	456, 052
Total Eastern district	657, 004	1, 116, 201	1, 773, 205
Southern district:			
Atlantic Coast Line	30, 359	7, 274	37, 633
Florida East Coast	4, 554	26, 958	31, 512
Illinois Central	11, 895	101, 248	113, 143
Louisville & Nashville	11, 244	23, 925	35, 169
Mobile & Ohio	589	33, 375	33, 964
Southern	25, 958	26, 233	52, 191
Yazoo & Mississippi Valley	36, 529	6, 701	43, 230
Other railroads	19, 173	114, 914	134, 087
Total Southern district	140, 301	340, 628	480, 929
Western district:			
Atchison, Topeka & Santa Fe	42, 397	23, 659	66, 056
Chicago & Alton	36, 262	29, 720	65, 982
Chicago & Northwestern	2, 260	26, 344	28, 604
Chicago, Milwaukee, St. Paul & Pacific	1, 350	31, 900	33, 250
Chicago, Rock Island & Pacific	1, 483	70, 663	72, 146
Great Northern	2, 520	19, 416	21, 936
International Great Northern	727	14, 530	15, 257
Kansas City Southern	21	16, 078	16, 099
Louisiana Railway & Navigation Co	14, 471	175	14, 646
Missouri Pacific	3, 437	39, 902	43, 339
St. Louis-San Francisco	1, 487	16, 045	17, 532
Southern Pacific	78, 667	8, 511	87, 178
Texarkana & Fort Smith	24, 680	54	24, 734
Texas & New Orleans	4, 310	24, 998	29, 308
Other railroads	10, 984	185, 890	196, 874
Total Western district	225, 056	507, 885	732, 941
Total United States	1, 022, 361	1, 964, 714	2, 987, 075

[1] Freight Commodity Statistics, Interstate Commerce Commission. The material terminated in 1928 is designated as "asphalt (natural, by-product, or petroleum)."

DISTRIBUTION BY WATER

Only about 12.8 to 15.4 per cent of the petroleum asphalt distributed in continental United States is carried by water at any stage of its distribution. Much of this asphalt is transferred to land carriers and included in the statistics of asphalt distributed by rail. Probably not more than one-tenth of the total amount of asphalt shipped in the domestic trade is transported wholly by water.

The principal movements of asphalt by water in domestic trade according to statistics published by the Board of Engineers of Rivers and Harbors, War Department, are the coastwise shipments from San Francisco Harbor to various points on the Pacific, Gulf, and Atlantic coasts; the coastwise shipments from Gulf coast ports (chiefly from Beaumont and Port Arthur) to various Gulf coast and Atlantic coast ports; and the intraport shipments from the refineries at Bayonne, Maurer, and Warners, N. J., to various points in and about New York Harbor.

Little asphalt is shipped to the noncontiguous Territories of the United States. According to the Bureau of Foreign and Domestic Commerce, shipments to Hawaii amounted to 9,121 short tons in 1926, 10,110 tons in 1927, and 103 tons in 1928. In 1926 2,354 tons was shipped to Porto Rico and in 1927 2,642 short tons, but none in 1928. No asphalt has been shipped to Alaska in recent years.

DOMESTIC DEMAND

In nine years the indicated domestic demand for both native and manufactured asphalts has virtually doubled, from 2,023,665 short tons in 1920 and 1,916,205 in 1921 to 4,362,270 tons in 1927 and 3,942,750 tons in 1928. From 1925 to 1928 petroleum asphalt has supplied four-fifths of the total demand and natural rock asphalt the remaining fifth. The indicated domestic consumption of petroleum and lake asphalt (exclusive of road oil) amounted to 2,910,026 short tons in 1925, increased to 3,203,240 tons in 1926 and 3,563,105 tons in 1927, but dropped to 3,161,153 tons in 1928.

Through the cooperation of the Bureau of Railway Economics, Washington, D. C., in obtaining from the principal asphalt-carrying railroads statements of the origin and destination of both original shipments and transferred shipments and through the courtesy of the Interstate Commerce Commission in permitting the Bureau of Mines free access to its records, it has been possible to determine with a reasonable degree of accuracy the consumption of asphalt by districts and by States in 1928. For purposes of comparison figures of distribution and consumption by districts for 1926 and 1927 have been inserted. Although the latter are based on less complete data than the figures for 1928 and contain estimates, it is believed that they present a reasonably accurate picture of the movement and consumption of asphalt in those years. Fair comparison is made somewhat difficult by the inclusion of varying amounts of natural rock asphalt, especially in the figures for 1926 and 1927.

Asphalt (petroleum, lake, and natural rock), exclusive of road oil, distributed by rail in the United States, 1926–1928, by districts, in short tons

District	1926	1927	1928
Northeastern	1,732,444	2,024,181	1,917,546
Southeastern	549,424	536,347	444,867
Southwestern	640,023	724,527	480,789
North Central	226,792	258,260	264,014
Pacific-Rocky Mountain [1]	397,096	382,436	408,620
	3,545,779	3,925,751	3,515,836

[1] Includes shipments by electric railroads, minor steam railroads, and motor trucks, as well as intraport shipments.

Petroleum and lake asphalt distributed by Class I and Class II railroads in the United States in 1928, by States

	Short tons		Short tons
Alabama	38, 863	Nevada	670
Arizona	8, 527	New Hampshire	9, 190
Arkansas	7, 019	New Jersey	211, 557
California	153, 471	New Mexico	2, 521
Colorado	8, 912	New York	286, 510
Connecticut	43, 843	North Carolina	29, 474
Delaware	5, 869	North Dakota	4, 116
District of Columbia	988	Ohio	329, 262
Florida	58, 815	Oklahoma	18, 671
Georgia	59, 925	Oregon	8, 950
Illinois	391, 057	Pennsylvania	289, 168
Idaho	118	Rhode Island	5, 694
Indiana	136, 602	South Carolina	25, 311
Iowa	14, 587	South Dakota	768
Kansas	8, 977	Tennessee	43, 675
Kentucky	39, 799	Texas	118, 248
Louisiana	65, 887	Utah	3, 166
Maine	7, 061	Vermont	6, 933
Maryland	22, 456	Virginia	26, 775
Massachusetts	152, 282	Washington	10, 909
Michigan	131, 516	West Virginia	22, 448
Minnesota	51, 857	Wisconsin	44, 976
Mississippi	15, 496	Wyoming	3, 152
Missouri	66, 062		
Montana	7, 115	Total	3, 013, 154
Nebraska	13, 906		

NORTHEASTERN DISTRICT

From three-fifths to two-thirds of the petroleum and lake asphalt and more than half of all asphalts (petroleum, lake, and rock), exclusive of road oil, distributed in the United States are consumed in the Northeastern district, which lies north of the Potomac and Ohio Rivers and east of the Mississippi and Illinois Rivers. Although this district comprises only about 12.4 per cent of the area of continental United States it contains over 48 per cent of the total population and 65 per cent of the urban population of the country. In it is conducted seven-tenths of the manufacturing of the Nation, as measured by the number of wage earners, the value of products, and the primary horsepower employed. In 1925, 83 to 85 per cent of the roofing materials manufactured in the United States, 62 to 66 per cent of the paving materials other than brick and cement, 65 per cent of the ready-mixed asphalt paints, and 91 per cent of the asphaltums, color varnishes, lithographic varnishes, etc., were produced in this district.

At the end of 1927 the district had 17,397.4 miles of rural highways surfaced with bituminous macadam, or 64.4 per cent of the total national mileage of roads of this type; 936.1 miles of road paved with sheet asphalt, or 33.6 per cent of the national total; 3,666.9 miles of bituminous concrete, or 41.9 per cent of the national total; and 38 miles of road paved with asphalt block, or 10.8 per cent of the national total. Altogether the district contained 56.6 per cent of the national total rural mileage of bituminous types of paving and 56.6 per cent of the national total mileage of rural roads suitable for motor traffic.

Three States—New York, Ohio, and Massachusetts—contained 81 per cent of the total mileage of bituminous macadam. The use of bituminous concrete, though less in amount, was more widespread; eight States—New Jersey, Pennsylvania, Massachusetts, Michigan, Ohio, New York, Connecticut, and Indiana—contained 92 per cent of the total mileage.

Complete statistics of rural highway construction in 1928 are not yet available. Of the 176.8 miles of Federal-aid highways paved with bituminous macadam completed in this district during 1928, 57.6 miles was laid in Massachusetts, 39.4 miles in Maryland, and 32.8 miles in Ohio. Only 35.2 per cent of the Federal-aid roads surfaced with bituminous macadam was laid in this area. Only 25.6 miles, or 10.6 per cent of the national total, was surfaced with bituminous concrete. Of this 12.9 miles was in Massachusetts, 6 miles in Delaware, and 3.5 miles in Ohio.

Source and distribution of asphalt (petroleum, lake, and natural rock), exclusive of road oil, Northeastern district, 1926–1928, in short tons

	1926	1927	1928
SOURCE			
Produced within district	1,619,521	2,113,933	2,013,355
Received by rail from:			
Southeastern district	427,193	442,815	470,075
Southwestern district	35,000	40,610	44,501
Pacific-Rocky Mountain district	2,000	2,500	2,928
Received by water (coastwise)	15,869	24,944	41,287
Imported	106,053	123,869	94,699
	2,205,636	2,748,671	2,666,845
DISTRIBUTION			
Shipped by rail:			
Within district	1,732,444	2,024,181	1,917,546
To North Central district	107,386	126,339	131,384
To Southeastern district	79,468	75,387	65,034
To Southwestern district	2,000	3,000	3,754
Shipped by water (coastwise and river)	219,301	307,244	302,300
Added to stocks	13,100	5,080	26,820
Exported	51,937	207,440	220,007
	2,205,636	2,748,671	2,666,845

SOUTHEASTERN DISTRICT

About 9 or 10 per cent of the national consumption of petroleum and lake asphalt (exclusive of road oil) and 12 to 15 per cent of the consumption of all asphalts (petroleum, lake, and natural rock) are in the area south of the Potomac and Ohio Rivers and east of the Mississippi and Pearl Rivers. This area contains 14.2 per cent of the area of the United States and 19.65 per cent of its total population but only 9 per cent of its urban population. Its basic industries are agricultural rather than manufacturing, although manufacturing, especially of textiles and steel, has increased rapidly in recent years.

Source and distribution of asphalt (petroleum, lake, and natural rock), exclusive of road oil, Southeastern district, 1926–1928, in short tons

	1926	1927	1928
SOURCE			
Produced within district	512,763	518,011	467,246
Received by rail from:			
Northeastern district	79,468	75,387	65,034
Southwestern district	398,654	400,191	411,978
Received by water (coastwise)	7,711	21,427	12,221
Withdrawn from stocks			1,920
Imported	34,990	33,061	24,875
	1,033,586	1,048,077	983,274
DISTRIBUTION			
Shipped by rail:			
Within district	549,424	536,347	444,867
To Northeastern district	427,193	442,815	470,075
To Southwestern district	35,000	40,000	41,092
To North Central district	20,000	25,000	26,889
Shipped by water (coastwise and river)	161		
Added to stocks	500	2,820	
Exported	1,308	1,095	351
	1,033,586	1,048,077	983,274

SOUTHWESTERN DISTRICT

Eight to ten per cent of the national consumption of petroleum and lake asphalt and 14 to 18 per cent of the national consumption of all asphalts are in the area west of the Mississippi and Pearl Rivers and south of St. Louis, Kansas City, Wichita, Amarillo, and El Paso. This district comprises 16.8 per cent of the area of continental United States but contains only 12.9 per cent of the total population and 8.4 per cent of the urban population. Even more than the Southeastern district its economy is based on the production of raw materials, agricultural and mineral. Its most important manufacturing industry is the refining of petroleum. Of the 288,000 short tons of petroleum asphalt estimated to have been consumed in this area in 1928, 89.9 per cent was distributed in Texas, Missouri, and Louisiana.

Source and distribution of asphalt (petroleum, lake, and natural rock), exclusive of road oil, Southwestern district, 1926–1928, in short tons

	1926	1927	1928
SOURCE			
Produced within district	1,245,845	1,418,382	1,178,997
Received by rail from:			
Pacific-Rocky Mountain district	14,000	15,000	16,716
Northeastern district	2,000	3,000	3,754
Southeastern district	35,000	40,000	41,092
Received by water (coastwise)	12,807	4,966	1,063
Withdrawn from stocks			1,500
Imported	1,580	1,157	
	1,311,232	1,482,505	1,243,122
DISTRIBUTION			
Shipped by rail:			
Within district	640,023	724,527	480,789
To Southeastern district	398,654	400,191	411,978
To Northeastern district	35,000	40,610	44,501
To North Central district	55,000	60,000	55,893
To Pacific-Rocky Mountain district	400	450	490
Shipped by water (coastwise)	119,323	135,819	121,200
Added to stocks	2,500	8,700	
Exported	60,332	112,208	128,271
	1,311,232	1,482,505	1,243,122

NORTH CENTRAL DISTRICT

Of the 264,014 short tons of asphalt (petroleum, lake, and natural rock) distributed in the North Central district in 1928, 203,688 tons or 77.15 per cent was consumed in Minnesota, in Wisconsin, and in Illinois west and north of the Illinois River. In the agricultural and grazing region extending from the Mississippi, Minnesota, and Red Rivers westward to the foot of the Rocky Mountains, and lying north of St. Louis and Kansas City, the consumption of asphalt per square mile was only 0.5 ton, or one twenty-third of the average consumption per square mile of the United States.

Source and distribution of asphalt (petroleum, lake, and natural rock), exclusive of road oil, North Central district, 1926–1928, in short tons

	1926	1927	1928
SOURCE			
Received by rail from:			
Northeastern district	107,386	126,339	131,384
Southeastern district	20,000	25,000	26,889
Southwestern district	55,000	60,000	55,893
Pacific-Rocky Mountain district	45,000	50,000	51,415
	227,386	261,339	265,581
DISTRIBUTION			
Shipped by rail within district	226,792	258,260	264,014
Exported	594	3,079	1,567
	227,386	261,339	265,581

PACIFIC-ROCKY MOUNTAIN DISTRICT

Nine to eleven per cent of the total national consumption of petroleum and lake asphalt (exclusive of road oil) and 10 to 12 per cent of the national consumption of all asphalts (petroleum, lake, and natural rock) are in the Pacific-Rocky Mountain district, lying west of Great Falls, Cheyenne, Denver, Albuquerque, and El Paso. Although this district comprises 34.4 per cent of the area of continental United States it contains only 7.9 per cent of the total population and 8.3 per cent of the urban population. In general, agriculture and mining rather than manufacture are its basic industries. Of the 365,000 short tons of petroleum asphalt estimated to have been consumed in this district in 1928, 91 per cent was consumed in California alone and 96 per cent in the three Pacific Coast States.

Source and distribution of asphalt (petroleum, lake, and native), exclusive of road oil, Pacific-Rocky Mountain district, 1926–1928, in short tons

	1926	1927	1928
SOURCE			
Produced within area	578,148	606,174	688,868
Received by rail from Southwestern district	400	450	490
Received by water (coastwise)	15,484	13,237	13,000
Withdrawn from stocks	----------	----------	8,800
Imported	9	10	13
	594,041	619,871	711,171
DISTRIBUTION			
Shipped by rail:			
Within district	226,802	242,579	232,332
To North Central district	45,000	50,000	51,415
To Southwestern district	14,000	15,000	16,716
To Northeastern district	2,000	2,500	2,928
Shipped by water (coastwise)	47,532	58,258	63,063
Shipped by electric railroads, minor steam railroads, and motor trucks, and intraport	170,294	139,857	176,288
Added to stocks	17,900	10,600	----------
Exported	70,513	101,077	168,429
	594,041	619,871	711,171

PRODUCERS

The following operators reported the production of asphaltic material from crude petroleum in the United States in 1928:

Atlantic Refining Co., 260 South Broad Street, Philadelphia, Pa.
Barber Asphalt Co., 1600 Arch Street, Philadelphia, Pa.
Beacon Oil Co., 30 Beachan Street, Everett, Mass.
Eureka Petroleum Corporation, Box 187, Arcade Station, Los Angeles, Calif.
Indian Refining Co., Lawrenceville, Ill.
Lincoln Oil Refining Co., Robinson, Ill.
Louisiana Oil & Refining Corporation, Shreveport, La.
Magnolia Petroleum Co., Box 1667, Dallas, Tex.
Mexican Petroleum Corporation, 122 East Forty-second Street, New York, N. Y.
Mexican Petroleum Corporation of Louisiana (Inc.), 122 East Forty-second Street, New York, N. Y.
Midwest Refining Co., First National Bank, Denver, Colo.
New England Oil Refining Co., Fall River, Mass.
New Orleans Refining Co., United Fruit Building, New Orleans, La.
Orange County Refining Co., 317½ East Second Street, Los Angeles, Calif.
Pan American Petroleum Co., 1034 Petroleum Securities Building, Los Angeles, Calif.
Paraffine Cos. (Inc.), 475 Brannan Street, San Francisco, Calif.
Seaside Oil Co., Summerland, Calif.
Sinclair Refining Co. of Louisiana (Inc.), 45 Nassau Street, New York, N. Y.
Standard Oil Co. of California, 225 Bush Street, San Francisco, Calif.
Standard Oil Co. (Indiana), 910 South Michigan Avenue, Chicago, Ill.
Standard Oil Co. of Louisiana, Baton Rouge, La.
Standard Oil Co. of New Jersey, 26 Broadway, New York, N. Y.
Standard Oil Co. of New York, 26 Broadway, New York, N. Y.
Standard Oil Co. of Ohio, East Ohio Gas Building, Cleveland, Ohio.
Sun Oil Co., 1428 South Penn Square, Philadelphia, Pa.
The Texas Co., Houston, Tex.
The Tidewater Oil Co., 11 Broadway, New York, N. Y.
Union Oil Co. of California, Union Oil Building, Los Angeles, Calif.
Warner-Quinlan Co., 2 Park Avenue, New York, N. Y.

ASPHALT ASSOCIATIONS

The members of the asphalt industry in 1919 established the Asphalt Association, which, in addition to other activities, collects and disseminates information useful to producers and users of asphalt. The address of the association is 441 Lexington Avenue, New York, N. Y. The officers are: President, L. M. Law, of the Shell Petroleum Corporation; vice presidents, W. H. Kershaw, of The Texas Co., and C. W. Bayliss, of the Barber Asphalt Co.; treasurer, Fisher Jones, of the Mexican Petroleum Co.; secretary and general manager, J. E. Pennybacker.

The Western Asphalt Association, composed of the leading producers of asphalt on the Pacific coast and the large contractors who build asphalt roads, was formed during the latter part of 1926. Its purpose is to educate the public as to the merits of asphaltic-type roads and to carry on research work. The headquarters of this association are at 650 South Grant Avenue, Los Angeles, Calif.

IMPORTS AND EXPORTS[3]

IMPORTS

Less asphalt was imported into the United States in 1928 than in any year since 1919. Only 119,588 short tons was imported in 1928, a decrease of 24.4 per cent from the imports of 1927 and of 13.8 per cent from the average imports from 1920 to 1927. Of the asphalt imported in 1928 Trinidad furnished 43.1 per cent, Venezuela 44.4 per cent, and Cuba 10.6 per cent. Since 1920 Trinidad and Venezuela together have supplied 86 to 99 per cent of the national imports, differing from year to year in their individual shares.

In recent years 70 to 75 per cent of the asphalt imported into the United States has entered through the Port of New York, and 98 or 99 per cent of the total has been received through the five customs districts of New York, Maryland, Virginia, Florida, and Mobile. In 1928 New York received 74.9 per cent of the total imports of asphalt; Mobile, 9.7 per cent; Virginia, 9.6 per cent; Maryland, 3.4 per cent; and Florida, 1.5 per cent.

Native asphalt and bituminous rock imported into the United States, 1924–1928, by countries

[General imports]

Country	1924		1925		1926		1927		1928	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
North America:										
Bermuda	------	------	4	$428	------	------	------	------	------	------
Canada	1,273	$17,105	9	920	167	$2,211	19	$673	614	$11,261
Mexico	------	------	([a])	25	1,668	24,390	------	------	52	1,105
West Indies:										
British—										
Barbados	20	2,430	76	5,123	190	7,861	21	2,292	22	2,752
Jamaica	------	------	836	8,360	------	------	------	------	------	------
Trinidad and Tobago	84,282	666,669	76,820	526,999	76,562	562,888	85,038	626,566	51,599	364,656
Other	134	600	58	1,336	------	------	2,319	17,419	------	------
Cuba	346	9,203	2,323	60,535	11,886	94,087	2,616	27,714	12,629	109,448

[a] Figures for quantity not available.

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[3] Figures on imports and exports compiled by J. A. Dorsey, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.

Native asphalt and bituminous rock imported into the United States, 1924–1928, by countries—Continued

Country	1924		1925		1926		1927		1928	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
South America:										
Argentina	------	--------	11	$182	12	$86	53	$1,111	------	--------
Colombia	55	$627	22	1,473	------	--------	------	--------	------	--------
Ecuador	------	--------	------	--------	4,637	30,636	------	--------	------	--------
Venezuela	73,309	490,895	37,160	246,558	46,292	305,854	66,254	437,744	53,046	$350,478
Europe:										
Azores and Madeira Islands	------	--------	------	--------	------	--------	(a)	5	------	--------
Belgium	------	--------	------	--------	------	--------	7	63	1	80
Czechoslovakia	------	--------	------	--------	------	--------	1	25	------	--------
Denmark	------	--------	------	--------	49	800	3	126	2	78
France	------	--------	------	--------	3	78	2	140	9	388
Germany	902	12,123	1,465	19,817	1,126	15,167	1,619	20,613	1,467	16,481
Italy	11	1,322	------	--------	------	--------	------	--------	1	26
Netherlands	(a)	5	1	12	(a)	10	2	310	13	638
Poland and Danzig	------	--------	------	--------	------	--------	4	100	2	25
Switzerland	1	233	3	185	2	483	58	495	2	499
United Kingdom	77	1,236	3,367	34,633	10	545	81	5,029	17	1,481
Yugoslavia and Albania	------	--------	------	--------	28	500	------	--------	------	--------
Asia: Palestine and Syria	7	711	7	838	------	--------	------	--------	------	--------
Africa: Egypt	------	--------	------	--------	------	--------	------	--------	112	5,650
	160,419	1,203,159	122,162	907,424	142,632	1,045,596	158,097	1,140,425	119,588	865,046

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[a] Figures for quantity not available.

EXPORTS

Exports of petroleum asphalt have grown rapidly in the four years for which statistics are available, from 89,014 short tons in 1925 to 146,589 tons in 1926, 385,031 tons in 1927, and 492,362 tons in 1928. Although the exports of petroleum asphalt in 1928 were 27.9 per cent larger than in 1927 more than 47 per cent of the 1928 total was shipped out during the first four months and nearly 67 per cent during the first six months of the year. The general upward tendency that had been manifested since January, 1925, broke sharply in May, 1928, the condition continuing through September. Although exports rallied slightly in the last three months they averaged only half as large as during the first six months of the year.

More than half of the 1928 exports went to northern and western Europe, chiefly to Germany, the Netherlands, the United Kingdom, France, Denmark, and Belgium, and over one-fifth to far eastern countries, chiefly to Australia, Netherland East Indies, Japan, China, and New Zealand. About one-tenth of the total was shipped to Canada, chiefly by rail across the northern border.

One-third of the petroleum asphalt exported in 1928 was shipped from Pacific coast ports, virtually all from San Francisco and Los Angeles; one-third from Atlantic coast ports, chiefly from Baltimore and New York; and nearly one-fourth from Gulf coast ports, almost entirely from New Orleans and Sabine. Rail shipments across the northern border to Canada have grown from 1,053 short tons in 1925 to 45,226 tons in 1928 and from 1.2 per cent of the total exports in 1925 to 9.2 per cent in 1928. Most of this traffic passes through Buffalo. To a smaller degree the share of the Gulf coast in these exports has increased, from 12.2 per cent in 1925 to 23.6 per cent in 1928, and of the Atlantic coast from 22.9 per cent in 1925 to 33.5 per cent in

1928. Conversely, the share of the Pacific coast ports in this foreign trade has decreased, from 63.8 per cent in 1925 to 33.8 per cent in 1928, although the actual exports have almost trebled in quantity. This is a reflection of the decreased relative importance of the far eastern trade, which is served chiefly by the Pacific ports, and the correspondingly increased importance of the trade with northern and western Europe, which is handled chiefly through the ports of the Atlantic and Gulf coasts.

Asphalt and related bitumens exported from the United States, 1919–1928

Year	Native asphalt				Petroleum asphalt		Total value
	Unmanufactured		Manufactures of	Total	Short tons	Value	
	Short tons	Value					
1919	40,208	$1,103,930	$606,918	$1,710,848	(1)	(1)	(1)
1920	51,706	1,356,116	842,074	2,198,190			
1921	45,367	1,178,038	621,224	1,799,262			
1922	57,362	1,344,440	[2] 1,261,125	2,605,565			
1923	72,628	1,500,869	[2] 2,075,628	3,576,497			
1924	52,568	1,245,670	[2] 2,212,260	3,457,930			
1925	32,835	825,654	[2] 2,525,618	3,351,272	89,014	$1,762,048	$5,113,320
1926	38,218	905,743	[2] 2,189,808	3,095,551	146,589	3,183,746	6,279,297
1927	39,875	1,034,334	[2] 2,399,700	3,434,034	385,031	8,325,413	11,759,447
1928	26,263	683,563	[2] 2,022,251	2,705,814	492,362	9,788,501	12,494,315

[1] Exports of petroleum asphalt not separately classified prior to 1925.

[2] Inclusive of value of squares (10 by 10 feet) of roofing asphalt as follows: 1922, 588,636 squares, $870,200; 1923, 783,028 squares, $1,124,491; 1924, 697,293 squares, $998,469; 1925, 661,662 squares, $919,977; 1926, 938,176 squares, $1,212,409; 1927, 853,842 squares, $1,150,722; 1928, 934,908 squares, $1,251,429. Corresponding exports not separately shown prior to 1922.

Asphalt exported from the United States in 1928, by countries

Country	Native asphalt and bitumen				Petroleum asphalt	
	Unmanufactured		Manufactures of, except roofing		Short tons	Value
	Short tons	Value	Short tons	Value		
North America:						
Bermuda	---	---	4	$129	113	$2,922
Canada	6,386	$124,380	3,872	134,007	47,799	728,539
Central America—						
Costa Rica	2	62	2	94	47	1,495
Guatemala	1	18	19	1,145	1	24
Honduras	3	120	118	4,041	---	---
Nicaragua	---	---	---	---	580	10,789
Panama	168	3,600	332	17,713	268	5,188
Salvador	---	---	---	---	1,170	24,216
Mexico	552	4,552	118	6,807	240	7,287
Newfoundland and Labrador	---	---	23	853	---	---
West Indies—						
British—						
Jamaica	---	---	1,381	69,660	15	707
Trinidad and Tobago	---	---	12	522	---	---
Other	---	---	70	2,456	165	4,500
Cuba	365	5,188	507	12,782	105	3,660
Dominican Republic	---	---	739	17,354	109	2,944
French	---	---	---	---	6	161
Haiti	36	730	3	193	164	5,492
Netherland	---	---	2	112	6	89
Virgin Islands of the United States	---	---	(1)	30	56	1,050
uth America:						
Argentina	73	2,539	589	23,098	3,975	86,686
Bolivia	---	---	(1)	102	---	---
Brazil	1,621	29,977	2,782	100,546	11,002	184,966

Less than 1 ton.

Asphalt exported from the United States in 1928, by countries—Continued

Country	Native asphalt and bitumen				Petroleum asphalt	
	Unmanufactured		Manufactures of, except roofing		Short tons	Value
	Short tons	Value	Short tons	Value		
South America—Continued.						
Chile	377	$7, 167	383	$12, 135	1, 082	$20, 792
Colombia	9	464	117	5, 004	355	6, 891
Ecuador	26	671	121	3, 697	477	12, 948
Guiana, British	----------	----------	1	274	----------	----------
Peru	165	2, 824	29	666	1, 314	20, 501
Surinam	----------	----------	(1)	32	10	160
Uruguay	7	213	267	8, 341	188	5, 349
Venezuela	----------	----------	159	7, 416	8	338
Europe:						
Austria	----------	----------	5	774	834	17, 337
Belgium	342	8, 826	111	4, 055	5, 078	92, 484
Czechoslovakia	----------	----------	10	1, 200	----------	----------
Denmark	----------	----------	1	130	16, 744	392, 262
Finland	16	405	82	4, 808	26	541
France	1, 699	56, 634	648	21, 949	30, 439	636, 014
Germany	5, 370	180, 627	1, 289	37, 648	103, 550	2, 300, 033
Greece	----------	----------	----------	----------	140	4, 023
Irish Free State	140	1, 700	----------	----------	1, 411	25, 184
Italy	405	12, 414	674	21, 880	11, 686	246, 382
Netherlands	529	22, 087	71	3, 306	55, 540	1, 202, 011
Norway	139	2, 713	11	499	346	7, 979
Poland and Danzig	22	450	----------	----------	357	8, 485
Portugal	----------	----------	----------	----------	1	45
Soviet Russia	----------	----------	24	649	----------	----------
Spain	746	18, 797	421	15, 845	14, 066	307, 659
Sweden	97	3, 676	103	4, 685	----------	----------
Switzerland	20	630	36	2, 817	1, 182	27, 095
United Kingdom	3, 659	115, 068	1, 257	60, 754	35, 736	816, 351
Asia:						
Ceylon	----------	----------	15	672	6, 003	107, 940
China	130	5, 909	69	10, 830	12, 143	213, 928
East Indies—						
British—						
India	111	2, 772	209	9, 329	9, 965	202, 854
Malaya	----------	----------	20	1, 102	4, 719	89, 585
Netherland—						
Java and Madura	----------	----------	2	193	22, 081	357, 875
Other	----------	----------	(1)	12	1, 462	27, 265
Indo-China (French)	----------	----------	----------	----------	5, 997	99, 518
Hong Kong	----------	----------	----------	----------	3, 508	65, 573
Japan, including Chosen	277	13, 047	534	39, 517	16, 300	298, 953
Kwantung	----------	----------	----------	----------	989	19, 114
Philippine Islands	4	230	----------	----------	4, 730	79, 607
Siam	----------	----------	----------	----------	1, 112	17, 071
Turkey in Asia	----------	----------	----------	----------	22	500
Africa:						
British—						
East	----------	----------	----------	----------	437	11, 313
South (Union of)	119	2, 862	266	12, 711	8, 251	128, 035
Other	----------	----------	45	2, 120	1	55
Canary Islands	----------	----------	----------	----------	58	1, 828
Egypt	10	120	101	6, 393	----------	----------
French—						
Algeria and Tunisia	----------	----------	----------	----------	2, 770	57, 309
Other	----------	----------	----------	----------	438	14, 714
Liberia	7	187	----------	----------	----------	----------
Morocco	----------	----------	----------	----------	459	9, 522
Portuguese—						
Mozambique	----------	----------	345	30, 117	887	22, 380
Other	----------	----------	----------	----------	11	281
Oceania, British:						
Australia	129	4, 060	1, 190	37, 391	33, 391	536, 519
New Zealand	2, 501	47, 844	331	10, 026	10, 121	202, 193
Other	----------	----------	2	201	116	2, 990
	26, 263	683, 563	19, 522	770, 822	492, 362	9, 788, 501

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[1] Less than 1 ton.

WORLD PRODUCTION

The United States is the largest producer of natural rock asphalt in the world. Its production averages about twice that of Italy, its nearest competitor, and more than six times that of Germany, which occupies third place.

On the other hand, Trinidad, with its famous Pitch Lake near Brighton, leads the world in the production of native asphalts of a high degree of purity. It is followed by Venezuela, whose Bermudez Lake, near Guanoco, State of Sucre, is almost equally well known. The United States owes its position in the third rank to the production of gilsonite, wurtzilite, and ozokerite in Utah.

No sufficiently complete statistics of the production of petroleum asphalt by the countries leading in oil refining are available. Nevertheless, such data as are at hand indicate that the United States leads all other countries in this industry.

Asphalt rock, natural asphalt, and related bitumens produced in the principal producing countries, 1924–1928, in metric tons [1]

[Compiled by L. M. Jones, of the Bureau of Mines]

Country and mineral [2]	1924	1925	1926	1927	1928
ASPHALT ROCK					
Albania	(3)	(3)	2,906	3,336	4,217
Canada (Alberta) [4]	482	1,041	479	2,455	85
France	51,465	52,446	58,240	48,530	54,710
Germany	57,359	64,115	60,966	117,836	158,329
Greece	5,013	5,256	402	290	3,173
Italy	186,581	272,990	312,790	356,154	242,300
Netherland East Indies	650	670	155	1,340	3,660
Rumania	19,731	15,709	24,891	30,712	8,875
Russia [5]	(3)	11,288	31,705	48,378	(3)
Spain	5,476	5,580	5,856	4,514	7,735
United States	477,023	494,468	610,305	722,206	689,908
Yugoslavia	97	286	85	46	535
NATURAL ASPHALT AND RELATED BITUMENS					
Barbados [6]	71	30	109	46	20
Cuba	3,643	2,814	7,988	4,116	13,186
France	26	16	27	(3)	(3)
Italy	663	678	735	791	2,178
Peru	2,708	1,068	690	892	981
Poland [7]	725	738	723	736	767
Rumania [7]	----------	3	----------	----------	----------
Russia [5] [7]	92	392	884	843	(3)
Switzerland [8]	33,159	35,757	28,200	36,716	(3)
Trinidad	227,460	204,335	241,109	246,017	199,125
United States	33,145	36,097	38,492	38,954	42,967
Venezuela	69,892	33,679	51,552	56,906	48,749

[1] Minerals included are asphalt rock, bituminous rock used for other purposes than the extraction of oil, native asphalt, asphaltite, manjak, and ozokerite. Oil shales, including ichthyolic shale, are not included.

[2] In addition to those listed, the following countries are reported to produce asphalt and related bitumens, but figures of annual output are not available: Colombia (reported to have produced 358 tons in 1925), Iraq, Madagascar, and Syria.

[3] Data not available.

[4] Bituminous sands.

[5] Year ended September 30.

[6] Exports of manjak.

[7] Ozokerite.

[8] Exports.

ACKNOWLEDGMENTS

The cordial cooperation of the Bureau of Railway Economics in obtaining from the principal asphalt-carrying railroads statements of the origin and destination of their shipments is gratefully acknowledged. Thanks are also due the Interstate Commerce Commission, the Bureau of Public Roads, the Bureau of the Census, and the Board of Engineers of Rivers and Harbors for their generosity in furnishing and making accessible information in their files.

COAL[1]

By F. G. Tryon, O. E. Kiessling, and L. Mann[2]

ACKNOWLEDGMENTS

This report marks the forty-seventh year of the continuous statistical record of coal production in Mineral Resources of the United States. Like its predecessors, the report is made possible by the voluntary cooperation of those interested in the coal industry, and it is a pleasure to record the generous support of the thousands of individual producers, distributors, and consumers who have supplied information.

Particularly valuable has been the help afforded by the traffic managers of the coal-originating railroads, who have furnished detailed records of shipments on their lines. For the weekly and daily information on cars of coal loaded, which forms the principal basis of the current estimates of weekly production, the bureau is under obligations to M. J. Gormley, chairman of the car service division of the American Railway Association, and particularly to H. E. Ewin and G. W. Freeburg. Current records of shipments by waterways have been furnished by the United States Engineers.

Acknowledgment is also made of the generous help of the State mine inspectors, who have assisted in the collection of returns by furnishing information in their files, thereby increasing the accuracy of the statistics. Help has been given by W. B. Hillhouse, chief mine inspector, Birmingham, Ala.; Claude Speegle, State inspector of mines, Fort Smith, Ark.; James Dalrymple, chief inspector of coal mines, Denver, Colo.; A. D. Lewis, director, department of mines and minerals, Springfield, Ill.; A. C. Dally, chief mine inspector, Indianapolis, Ind.; J. R. Frank, secretary to the mine inspectors, Des Moines, Iowa; James Sherwood, State mine inspector, Pittsburg, Kans.; J. F. Daniel, chief inspector of mines, Lexington, Ky.; John J. Rutledge, chief mine engineer, Maryland bureau of mines, Baltimore, Md.; F. G. Fenix, chief inspector, Joplin, Mo.; Edward Davies, State coal-mine inspector, Helena, Mont.; A. Waddington, State coal-mine inspector, Bismarck, N. Dak.; G. F. Miles, chief, division of labor statistics, Columbus, Ohio; Miller D. Hay, chief mine inspector, Oklahoma City, Okla.; Frank Hall, deputy secretary of mines, department of mines, Harrisburg, Pa.; O. P. Pile, chief mine inspector, Nashville, Tenn.; John Hopkins Hall, commissioner of labor, Richmond, Va.; William R. Reese, chief mine inspector, Seattle, Wash.; R. M. Lambie, chief, department of mines, Charleston, W. Va.; and Lyman Fearn, chief coal-mine inspector, Rock Springs, Wyo.

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[1] Work on manuscript completed December, 1929.

[2] The work incident to the preparation of coal statistics was done by the following employees of the Bureau of Mines: Compilation of the annual statistics of bituminous coal was conducted by L. Mann, with the assistance of J. M. Corse; the statistics of anthracite were compiled by H. L. Bennit; the monthly and weekly estimates of production were prepared by R. McKinney; the distribution tables by R. McKinney and G. S. Goodman; the figures of consumers' stocks were compiled by H. O. Rogers, who also conducted the study of preparation; the data on world production were compiled by L. M. Jones; and the tables of exports and imports were compiled from the records of the Bureau of Foreign and Domestic Commerce by J. A. Dorsey. The sections on seasonal fluctuations in production, preparation (sizing and cleaning), loading machines underground, and consumption are adapted from special studies by F. G. Tryon and H. O. Rogers, to be published elsewhere. O. E. Kiessling wrote the market review and the section on anthracite and collaborated with F. G. Tryon in writing the other sections of the report. The anthracite section of the report was printed in advance of the report as a whole and distributed in January, 1930, under the title "Anthracite in 1928, by O. E. Kiessling and H. L. Bennit."

The bureau finds of especial value the cooperation of the secretaries of local associations of coal operators, on account of their intimate knowledge of conditions in their several districts. Many of them have supplied current reports of production by fields. For information on 1928 the bureau is indebted to F. O. Sandstrom, secretary, Colorado and New Mexico Coal Operators' Association, Denver, Colo.; F. C. Honnold, manager, Honnold Coal Bureau, Chicago, Ill.; P. H. Greenlaw, secretary, St. Louis Coal Bureau, St. Louis, Mo.; Jonas Waffle, traffic manager, Indiana Bituminous Coal Operators' Association, Terre Haute, Ind.; C. E. Reed, secretary, West Kentucky Coal Bureau, Louisville, Ky.; J. E. Johnson, secretary, Hazard Coal Operators' Exchange, Lexington, Ky.; E. R. Clayton, secretary, Harlan County Coal Operators' Association, Harlan, Ky.; C. B. Neel, secretary, Virginia Coal Operators' Association, Norton, Va.; A. W. Laing, treasurer, Winding Gulf Operators' Association, Beckley, W. Va.; S. C. Higgins, secretary-traffic manager, New River Coal Operators' Association, Mount Hope, W. Va.; T. M. Moran, secretary, Fairmont Coal Operators' Association, Fairmont, W. Va.; A. O. Wilson, statistician, Kanawha Coal Operators' Association, Charleston, W. Va.; W. L. A. Johnson, general commissioner, Southwestern Interstate Coal Operators' Association, Kansas City, Mo.; and W. E. Maltby, manager, Washington Coal Producers' Association, Seattle, Wash. To these and many others who have supplied information cordial acknowledgment is made.

REVIEW OF COAL INDUSTRY IN 1928

BITUMINOUS COAL

Conditions in the bituminous-coal industry, which in 1927 left their imprint in declining output and falling prices, continued throughout 1928. In fact, the statistical record of production and values failed to show any major improvement in 1928. On the economic side of the industry the record was generally below the level of the preceding year, when the situation in the soft-coal fields left much to be desired.[3] The important short-time influences dominating the bituminous-coal market in 1928 were: (1) An abundant supply of coal at all times and places and (2) a weak demand, due to a slight drop in the total domestic consumption, to a further loss in export business, and to withdrawals from stock piles for supplying current needs. A calm market and adequate supplies prevailed during the year, and there was nothing spectacular in the current trends of production or prices.

The total output of bituminous coal in 1928 was 500,744,970 net tons—the lowest for any of the past four years and a decrease of

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[3] Tryon, F. G., Kiessling, O. E., and Mann, L., Coal in 1927: Mineral Resources of the United States, 1927, Pt. II, Bureau of Mines, 1929, pp. 328–334.

3.3 per cent from 1927. (See fig. 9.) Production during the first three months was 131,615,000 tons, or 22.2 per cent below that in the corresponding period of the preceding year. It should be remembered, however, that during the first three months of 1927 demand was stimulated sharply by a high level of industrial activity and by storage requirements in anticipation of the expiration of the Jacksonville agreement on March 31. Output in each of the remaining quarters exceeded comparable figures for 1927. (See Table 17.) In fact, the total production of 369,130,000 tons in the last 9 months showed a gain of 5.9 per cent over the same period of 1927. Partial restriction of mining in a number of important union areas from April to September, pending the consummation of new district agreements, was counteracted by the maintenance of production at approximately winter levels in the fields of West Virginia and eastern Kentucky. (See Table 18.) Weekly output for the 15 weeks from September 15 to December 22 was held at a remarkably steady point well above 10,000,000 tons. (See Table 15.) Although there was a noticeable upward trend during the latter part of the year, production came far from approaching any of the established monthly or weekly records and it was largely governed by the dictates of a quiet market. Coincident with the decline of production in 1928 the industry experienced a price recession that was reflected in both a lower total sales realization and in a decreased average value per ton.

Slight decline in industrial consumption.—The total consumption of bituminous coal in 1928 was 498,828,000 tons, only 973,000 tons less than in 1927—a decline of 0.2 per cent in consumption as contrasted with a reduction of 3.3 per cent in output. So slight a decrease in consumption as occurred in 1928 could hardly have been of great importance in accentuating the weak market that prevailed. In fact, close observers of the industry regarded the use of soft coal at about the 1927 level as an encouraging feature of the trade in 1928.

The figure of total bituminous-coal consumption in 1928 fails to give an adequate picture of the demands of industry during the year. The volume of output in most lines of business increased sharply in the first months and attained higher levels in the fall and early winter. For the year manufacturing production showed an increase of 4.7 and 2.8 per cent over 1927 and 1926, respectively. In comparison with 1926, a period of notable industrial activity and high coal consumption, 1928 showed an increase of 5.3 per cent in iron and steel products, 3.7 per cent in automobile output, and 3.5 per cent in cement, brick, and glass production—all industries requiring a large consumption of coal per unit of product.[4] However, the increased demand for fuel due to the large volume of manufactures was just about offset by reduced consumption in some other lines of business For example, locomotives of Class I railroads, doing about the same work as in the preceding year, consumed 7,810,000 tons less than in 1927 and 17,704,000 tons less than in 1926.[5]

Further decline of export trade.—Another factor that contributed to the weak market in 1928 was further reduction in the export demand. Total exports were 16,164,485 net tons, as compared with 18,011,744, 35,271,937, and 17,461,560 tons in 1927, 1926, and 1925, respectively.

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[4] Federal Reserve Bulletin, vol. 15, No. 2, February, 1929, p. 117.

[5] Bureau of Railway Economics, Capital Expenditures and Purchases in the Railway Industry: Misc. Series 48 ,Washington, 1929, p. 19.

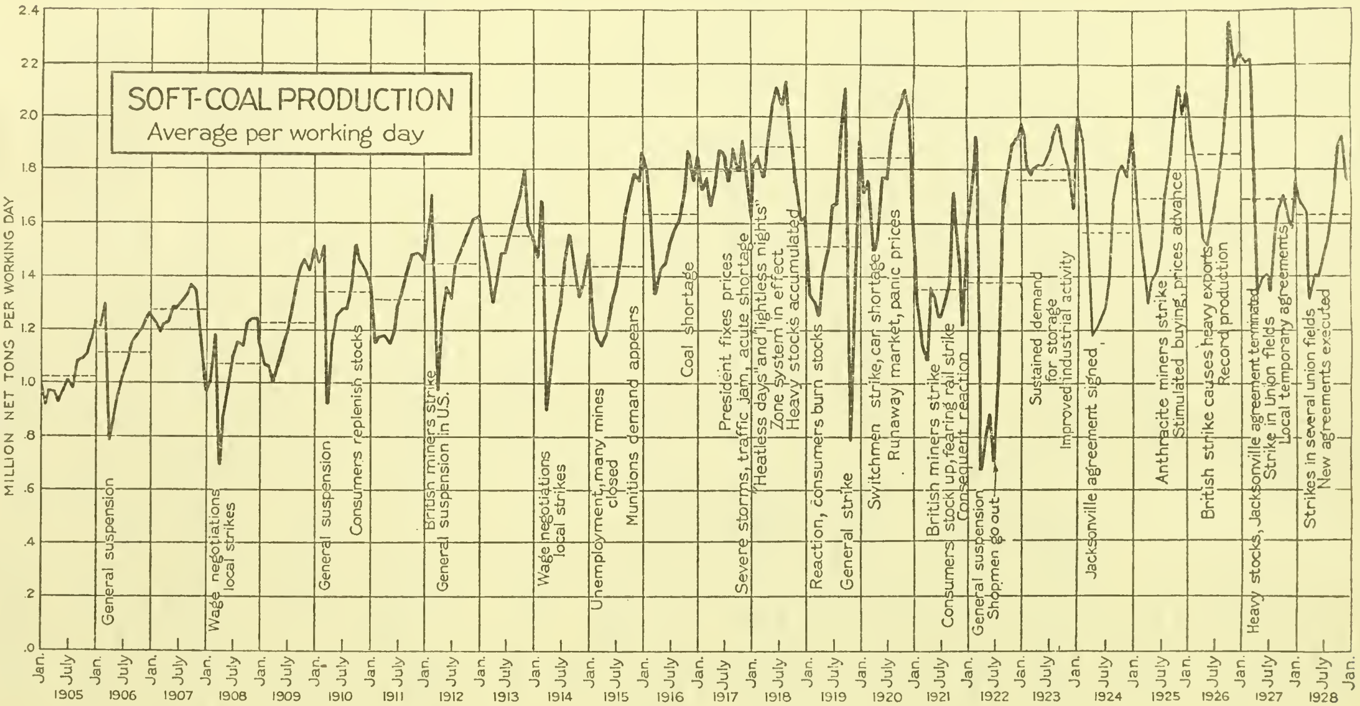

FIGURE 7.—Average production of bituminous coal per working day in each month, 1905–1928

(See Table 78.) Shipments overseas and to Mexico totaled 2,205,524 tons, a decline of 35.5 per cent from 1927 and a figure equivalent to about one-tenth of the record tonnages of 1926 and 1920. The declines noted when 1928 is contrasted with 1927 appear more striking when it is recalled that overseas business in the latter year was exceptionally light.[6] (See fig. 22.) A study of Table 78 indicates that the 1928 movement of American coal to the principal markets in South America and Europe was at a very low ebb compared with other recent years. Exports to Canada, of about the same volume as in 1925 and 1926, decreased 4.4 per cent from 1927. In addition, the quantity of bunker coal loaded into vessels engaged in foreign trade was 271,055 tons less than in 1927 and 571,298 tons less than in 1925. The combined demand for total export and foreign bunker coal in 1928 was thus 2,118,314 tons less than in 1927. The decrease did not involve sufficient tonnage to dominate the market, but its influence was felt in connection with other, more significant, conditions.

Withdrawals from storage to supply current needs.—The withdrawal of 13,700,000 tons of coal from storage during 1928 was a major influence in temporarily depressing the demand for fresh-mined coal. It will be remembered that at the expiration of the Jacksonville agreement on April 1, 1927, coal stocks in the hands of consumers stood at the unprecedented figure of 75,000,000 tons. In consequence of the obvious ability of the industry to meet all requirements easily these huge reserves were curtailed to 55,500,000 tons by the beginning of 1928. Between January and April, 1928, an additional 7,200,000 tons was withdrawn from the stock piles. In the second quarter, with production at the lowest point of the year, coal stocks were decreased further and on July 1 amounted to 41,700,000 tons. No appreciable change occurred during the remainder of the year, which ended with reserves of 41,800,000 tons on hand. (See fig. 8.) The net decrease in consumers' stocks in 1928 was thus 13,700,000 tons, a quantity equivalent to 81 per cent of the difference between 1927 and 1928 production. Despite this sizable reduction the quantity in storage at the end of December was still large enough to insure a quiet market.

Importance of long-time economic forces.—Smaller consumption, reduced exports, and withdrawals from storage go far to explain the decrease of 1928 production in comparison with that of the preceding year, but it is necessary to go beyond immediate events to understand why the condition of the industry in 1927 and 1928 was not all that might be desired. The depression in these two years is in no small measure a reflection of certain long-time economic forces, the most significant of which is an arrested demand for coal (fig. 11) due to fuel economy and to the growth of oil, gas, and water power as sources of energy. (See figs. 12 and 13 and Table 7.) These developments have been thoroughly discussed in a preceding report of this series. (Coal in 1926, pp. 443–456.) In studying the coal market in 1928 it should be remembered that long-time considerations of supply and demand, as well as short-time factors, had a definite bearing upon curtailed production and lower prices.

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[6] Tryon, F. G., Kiessling, O. E., and Mann, L., Coal in 1927: Mineral Resources of the United States, 1927, Pt. II, Bureau of Mines, 1929, p. 329.

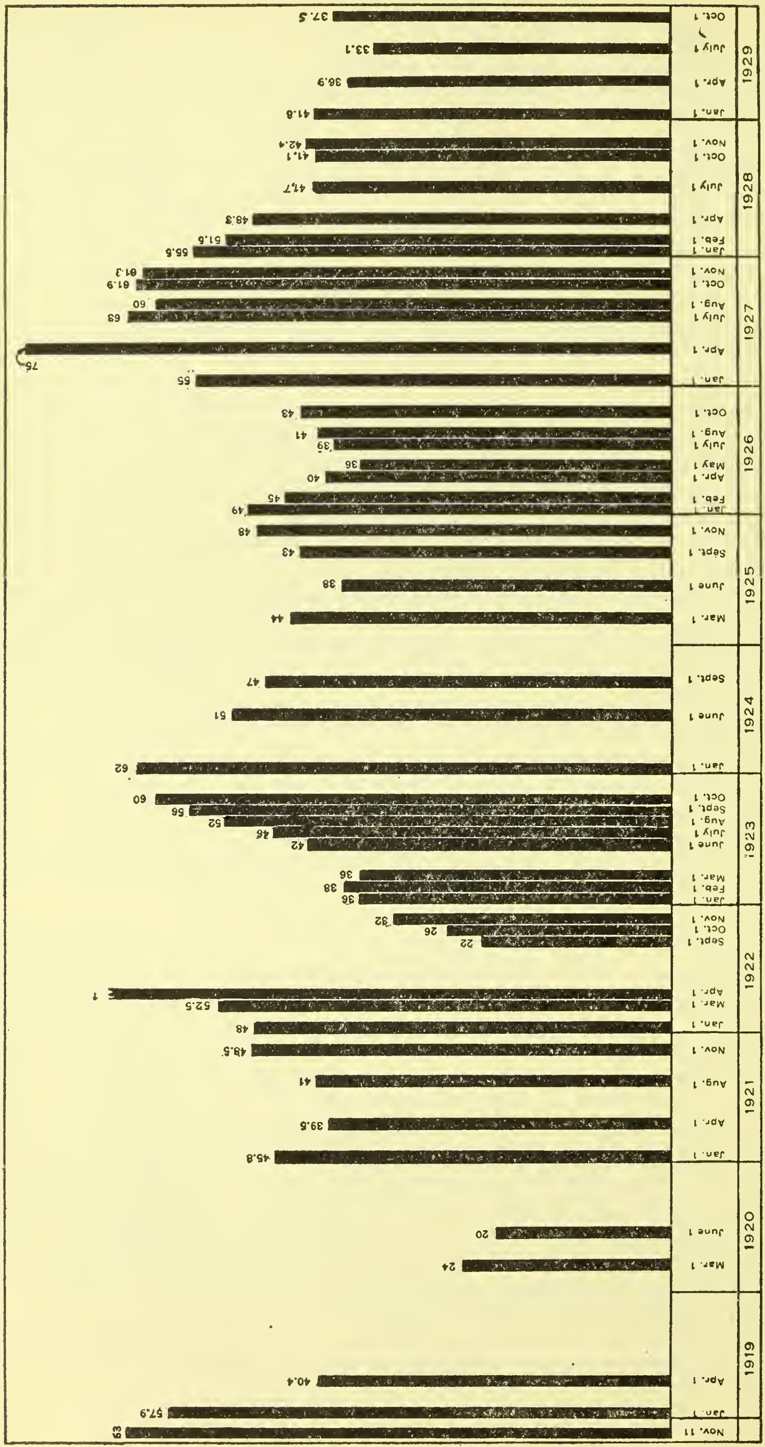

FIGURE 8.—Total commercial stocks of bituminous coal, November 11, 1918, to October 1, 1929. Coal on lake docks, in transit, and in the stores of householders is not included

Prices and values in 1928—lowest of decade.—Reacting to conditions already noted, the trend of bituminous coal prices was downward in 1928. Spot prices for the country as a whole fluctuated within rather narrow limits, largely in accord with the seasonal demand for fuel. They were highest during the first months of the year, followed by a dip that lasted until fall, when prices were strengthened by the winter demand. The trend is clearly indicated by Coal Age's weighted average spot price for 14 coals f. o. b. mines, $1.87 for the first quarter and $1.73, $1.75, and $1.83 for each of the succeeding 3-month periods.[7] For December the weighted average was $1.81, as against $1.85 for January. (See fig. 10.) The average of $1.80 for the year was the lowest reported for any similar period since 1915 and represents a decrease of 19 cents from 1927.

The course of the weighted average spot price reflected the trends prevailing in most markets. The average of spot prices of southern West Virginia low-volatile mine-run on the Columbus, Chicago, Cincinnati, and Boston markets was $1.89 for January, $1.74 for May, and $1.93 for December. Spot prices of southern Illinois run-of-mine on the Chicago market decreased from $2.38 at the first of the year to $2.15 in June and recovered to $2.33 in October. The average of quotations on western Kentucky mine-run on the Chicago and Louisville markets dropped from $1.16 in January to 99 cents in July; for December the average was $1.09. In most markets, year-end prices were lower than those for the first months.[8]

The level of spot prices, however, is somewhat below the trend of sales realizations in 1928. For the industry as a whole the average sales realization on all coal produced was $1.86, or 6 cents above the Coal Age average spot price. Nevertheless, the 1928 average value per ton f. o. b. mines was the lowest since 1916 and represents a reduction of 13 cents from 1927. All but six States shared in the decline in sales realizations. In the Southeast, the average value per ton for Alabama was the same as in 1927, while the average for Georgia increased 6 cents. One large area—the southern Rocky Mountains—constituted an exception to the general tendency of declining values. In Colorado, Utah, and New Mexico sales realizations were better than in 1927. (See Tables 2 and 27.) But the five States showing increased values per ton produced only 3.5 per cent of the total 1928 output, and the increases were more than offset by reductions in other fields. The lower value per ton and the smaller output reduced the total value of all coal produced in 1928 to $933,774,000, a decline of $95,883,000 in comparison with 1927. Moreover, it is noteworthy that the total value for the year was less than one-half of the 1920 figure, and for the first time in a dozen years it dropped below $1,000,000,000.

The declines in prices and values may perhaps give an exaggerated impression of losses suffered by the operators; however, wages, the largest item in the cost of producing coal, also decreased in 1928. In connection with a series of individual district agreements, completed during the last four months of the year, lower wage scales went into effect in most of the union areas. The extent of the reductions, however, varied among the different fields. Some idea of the decreases can be obtained by comparing the new scales with the old basic day rate for underground labor, which had been $7.50 in most districts.

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[7] Coal Age, vol. 34, No. 1, January, 1929, p. 56.
[8] Idem, p. 59.

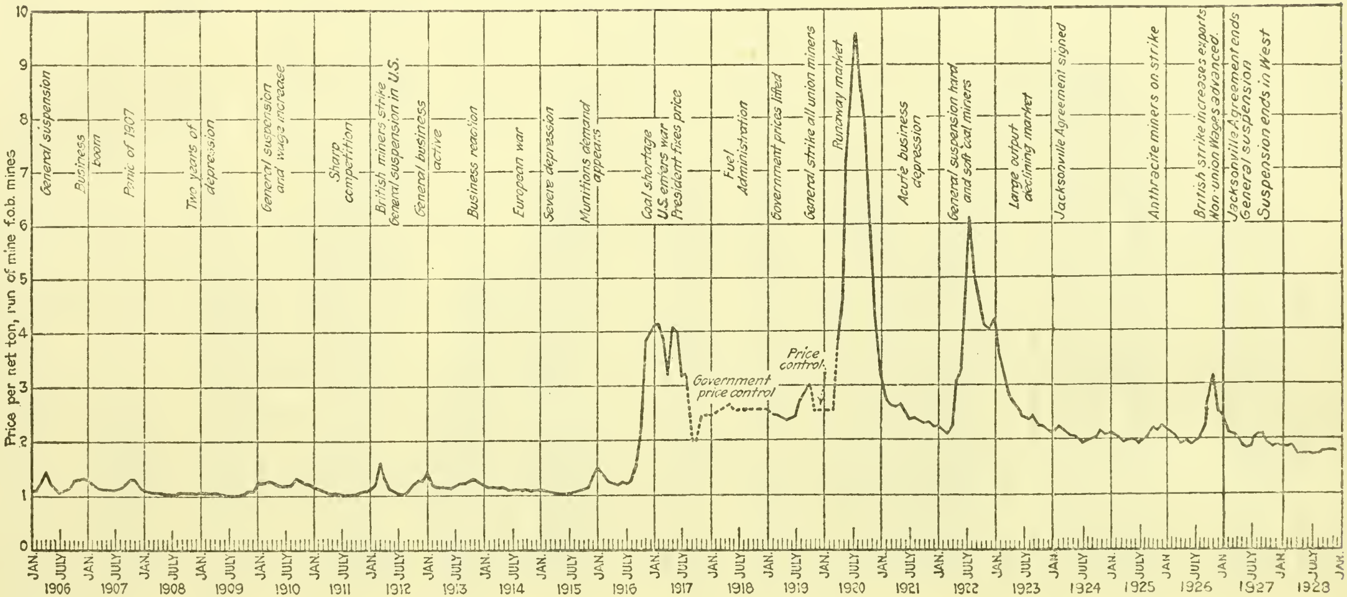

FIGURE 9.—Monthly average spot prices of bituminous coal f. o. b. mines, as quoted by Coal Age, 1906–1928

For Illinois and Indiana the new rate was fixed at $6.10 and for Iowa at $5.80. Ohio and the Southwestern States returned to the $5 level of 1917, and in Michigan there was a 19 per cent reduction for all classes of labor except mechanical loading. In Montana the new basic day-wage rate for miners was $7.19, and in Wyoming there was a reduction of $1.20 per day from the old rate for inside day work.[9] How far these reductions in union rates were followed by further cuts in the nonunion fields is not known. Definite announcement of reductions at mines in western Kentucky was made,[10] and rumors of cuts in other fields were not lacking. It is known that in the nonunion, as in the union fields, average prices declined in 1928, although generally to a smaller degree.

New record in lake cargo movement.—An encouraging feature of the bituminous market in 1928 was a record movement of cargo coal in the lake trade. The total quantity loaded into vessels at Lake Erie ports was 34,765,743 tons, of which 33,402,121 tons was cargo coal. Cargo dumpings exceeded the previous record established in 1927 by 550,440 tons. Although the lake coal traffic was about four weeks behind that of the preceding year in getting under way the delay was counteracted by monthly loadings of more than 4,000,000 tons from May to November. The shipment of 5,460,688 tons in August represents a new record in monthly loadings. Of the total shipments 27,759,438 tons went to American and 5,642,680 tons to Canadian ports. A reduction of 2,292,871 tons in shipments to American ports on Lake Superior in comparison with 1927 was more than offset by increased receipts at other American ports.

As already noted the total lake business in 1928 was the largest in history. The degree to which the various fields shared in the record tonnage depended partly on the extent to which mining was curtailed owing to the labor suspension prevailing during the middle of 1927 and renewed in 1928 in a number of areas and partly on the developments of the now famous lake cargo rate controversy. In 1928 Pennsylvania supplied 6,630,671 tons of lake cargo coal, or 19.9 per cent of the total, as compared with 11 per cent in 1927. Although Pennsylvania's lake tonnage for 1928 was the largest in the past five years, it was well below the 8,149,733 tons for 1918. Lake shipments originating in West Virginia were 18,802,155 tons, as compared with 21,572,429 tons in 1927 and 9,155,383 tons in 1918. Eastern Kentucky supplied 6,651,962 tons of lake coal, a reduction from 1927 but a large increase over the 1918 figure of 1,314,554 tons. Ohio, where mining has been extensively curtailed in the past two years, during the lake season supplied 346,104 and 1,053,032 tons of cargo coal in 1927 and 1928, respectively, as against 9,536,734 tons in 1918.

Decrease in number of mines and miners in 1928.—A further reduction in the number of operations and in the labor force indicates the long-time economic forces set in motion by the changed conditions of the coal market. (See Coal in 1926, pp. 443–456.) Since 1923, 2,881 commercial mines ceased operation (see fig. 15), 183,000 men lost their jobs, and 210,000,000 tons of mine capacity was closed down. (See fig. 14.) Although the 1928 output declined only 3.3

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[9] U. S. Bureau of Labor Statistics, Monthly Labor Review: Vol. 28, No. 2, February, 1929, pp. 204–208; Coal Age, vol. 33, No. 9, September, 1928, p. 566.

[10] Coal Age, vol. 33, No. 10, October, 1928, p. 650.

per cent in comparison with the preceding year, there was a reduction of 8 per cent in the number of mines and 12.1 per cent in the number of workers.

The total number of commercial mines active in 1928 was 6,450, as compared with 7,011 in 1927 and 9,331 in 1923. The tendency to reduce the number of mines in recent years has increased the importance of the larger producing operations. (See fig. 15.) For example, in 1923 mines producing more than 100,000 tons a year supplied about 70 per cent of the Nation's coal; in 1928 their share was over 80 per cent.

The reduction in the labor force in 1928 was widespread and serious. The total number of men employed at bituminous coal mines was 522,150, or 71,768 less than in 1927. Small increases in the number of workers in three Southeastern and four Western States, ranging from 10 in Georgia to 422 in Oklahoma, failed to make up the very large losses in other areas—particularly in the central and eastern fields. In comparison with 1927, the working force in Kentucky decreased 2,552 men, in Illinois 12,704, in Indiana 7,546, in Ohio 14,172, in Pennsylvania 20,285, and in West Virginia 8,066 men; reductions in the number of workers in the remaining States, except the seven showing small increases, ranged from 6 in North Dakota to 1,907 in Alabama.

Steadier working time in 1928.—Those who held their jobs, however, worked more steadily than in 1927. The average time worked by the 6,450 commercial mines in 1928 was 203 days, an improvement of 12 days over the preceding year. The steadiness of employment among the several coal-producing States varied considerably, as has usually been the case, but these differences were not so marked for the industry as a whole as in 1927.

Progress made in engineering.—Although the economic record of the bituminous-coal industry in recent years has left much to be desired, notable progress has been made in the technology of mining and preparation. The improved methods of mining coal due to the increased use of electric drilling and cutting machines (fig. 16), to the rapid introduction of mechanical loaders (figs. 17 and 18), and to the electrification of mine power and haulage are treated on pages 481 to 487 of this report. With new devices underground improvements in preparation equipment became necessary. The shaker screen, the picking table, and recent developments in mechanical cleaning by both wet and pneumatic methods handle a large tonnage and improve the quality of the product. (See figs. 19 and 20.) Statistical data on coal preparation will be found on pages 506 to 508.

Increased productivity per worker.—The net result of engineering progress is seen in the increasing output per worker. In 1913 the production per man per day in bituminous coal mines was 3.61 short tons. In 1928 it was 4.73 tons, a gain of 0.18 ton over 1927 and an increase of 1.12 tons in the 15 years since 1913.

PENNSYLVANIA ANTHRACITE

In comparison with the preceding year, the Pennsylvania anthracite industry in 1928 was characterized by important downward trends—in production, shipments, number of operations, working time, number of men employed, and in sales realizations obtained for domestic sizes. These declines are the more significant when it is recalled that in many respects the record for 1927 was the poorest for any year free from labor difficulties in the decade beginning with 1918. As a notable exception to the general trends in 1928, the average prices for steam sizes were the highest since 1924, and the average for the entire steam group represented a gain of 7 per cent over 1927. This improvement, however, shared by only 29 per cent of the breaker output, was inadequate to offset the losses on the high-priced domestic sizes, and the average sales realization on shipments of breaker coal was $6.38, as against $6.50 in 1927. Owing both to the lower value per ton and to the smaller tonnage, the value of the total output of the industry fell to $393,638,000 in 1928, a loss of 6.5 per cent, in comparison with the 1927 value of $420,942,000.

The total production of Pennsylvania anthracite in 1928 was 67,275,062 gross tons, a decrease of 4,238,834 tons, or 5.9 per cent, when compared with 1927. Shipments to markets outside the anthracite region were 5.3 per cent below the average for the 10 years 1919–1928, which amounted to 62,717,272 tons, and 5.7 per cent below the 1927 level.

When consumption is considered, however, the status of anthracite in 1928 appears much less discouraging. Taking into account large withdrawals from producers' storage yards, the total consumption was 65,759,000 tons. (Table 1A.) Compared with 1927, this represents a decline of only 1.4 per cent as contrasted with reductions of 5.9 per cent and 5.7 per cent in production and shipments, respectively.

During the first four months of 1928, when production was 2,212,000 tons, or 8.7 per cent behind that for the same period in the preceding year, retailers were drawing upon reserves. Supplies of anthracite in the yards of representative retail dealers, sufficient for 57 days on January 1, were adequate for only 25 days on April 1. With the coming of summer, the allowance of the usual discounts failed to stimulate an unusually dull mid-year market, attributed by the trade to the increased disinclination of consumers to lay in supplies ahead of requirements. (Coal Age, vol. 34, No. 1, January, 1929, p. 57.) Retailers took advantage of the summer slump to rebuild depleted stock piles, and dealers' reserves remained at a high level during the last half of the year. Periods of intermittent brisk demand during the late autumn and early winter stimulated sales somewhat, and production during the last quarter showed a gain of 8.1 per cent over the comparative figure for 1927. (Table 5A.)

The relative weakness of the anthracite market is probably indicated most clearly by lower sales realizations on breaker shipments of domestic coal. The average of $8.09 for all domestic grades was the lowest for any year since 1922 and represents a decline of 2.9 per cent from 1927. In comparison with the latter year, every size in the domestic group showed declines in average values, and these decreases ranged from 2 cents a ton on egg to 90 cents a ton on pea. (Table 20A.) The sharp drop of 15.3 per cent in the average value of pea between 1927 and 1928 has in itself meant a loss of over $3,500,000 to the industry.

In contrast with what happened to the domestic grades, sales realizations for each of the steam sizes showed an improvement over 1927, and the increases ranged from 6 cents a ton on buckwheat No. 3 and barley to 19 cents a ton on buckwheat No. 1. The average for all steam sizes was $2.12, the highest since 1924 and a gain of 7 per cent over 1927. The grand average for all breaker shipments in 1928, including both steam and domestic coal, was $6.38—the lowest since 1921.

The course of anthracite prices from month to month during 1928 shows the large extent to which seasonal demand dominated the weak market. The year opened and closed with quotations, both company and independent, at approximately the same levels, and the intervening period was marked by an almost regular sag and recovery of the price curve, which reached its lowest point in the second quarter. Although circular prices were adhered to by the larger companies, the mid-season discounts on company stove and pea were larger and of longer duration than in 1927. (Saward's Annual: 1928, pp. 19–20; 1929, pp. 20–21.) In fact, the company price of pea at $5 from April to December amounted to at least a temporary reduction rather than a summer discount when compared with the price of $6 to $6.50 for the same grade that prevailed throughout the preceding year. The prices of independent domestic coals were generally below the company figures, but small intermittent premiums were paid when the early winter demand was felt. In April and May independent stove, as quoted on the New York market, reached the lowest point since 1922, but with the coming of autumn it brought small occasional premiums. (Coal Age, January, 1929, vol. 34, No. 1, p. 58.) Independent buckwheat remained at a remarkably steady level below the company price throughout practically the entire year in contrast to the record for the past

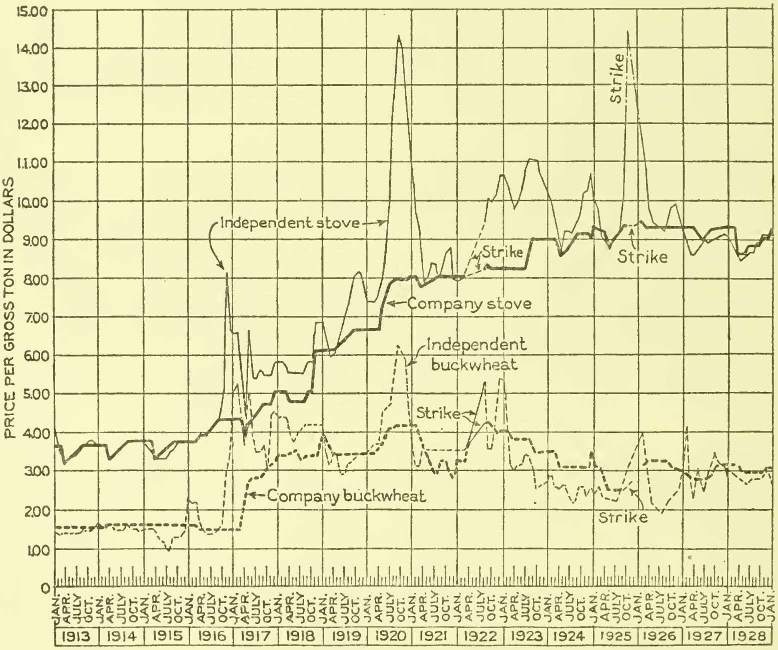

FIGURE 10.—Monthly prices of Pennsylvania anthracite f. o. b. mines, as quoted by Coal Age, 1913–1928. Prices shown are averages of the range as quoted on the New York market

three years characterized by sporadic increases above the company quotation.

A further reduction in the number of operations is indicative of the economic conditions forcing an adjustment of productive capacity to accord with the requirements of the changing market. Two-hundred and twenty-six breakers produced anthracite in 1928, a smaller number than since the beginning of the record in 1918. In comparison with 1927, there was a decrease of 9 in the number of active breakers and in comparison with 1923 a decrease of 31.

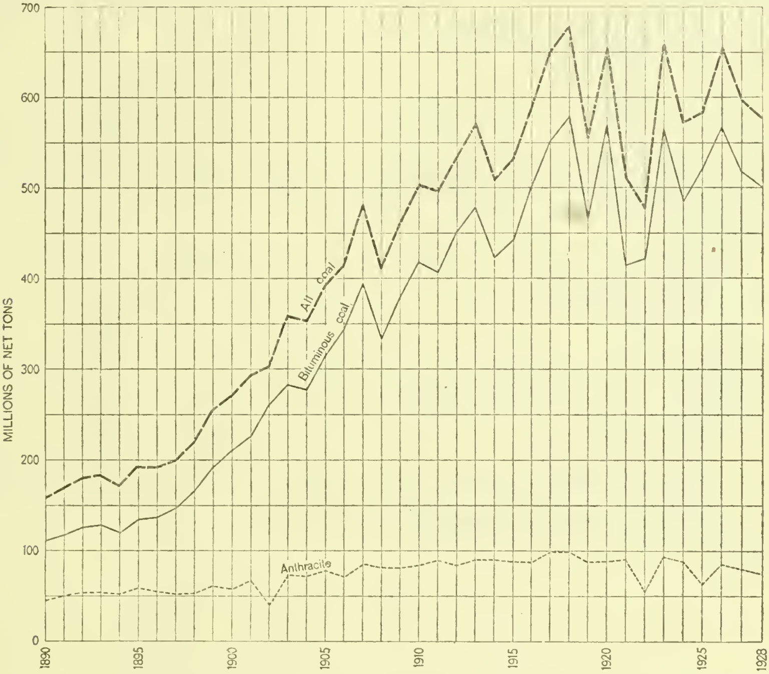

FIGURE 11.—Production of bituminous coal, Pennsylvania anthracite, and all coal, 1890–1928

In addition, the smaller number of breakers worked fewer days and employed less men than in 1927. The average number of days worked by breakers was 217, a loss of 28 and 8 days from 1926 and 1927, respectively. The total number of men and boys working at breakers, not including supervisory forces and office workers, was 159,662, or about the same number as was employed in 1924 and 1925. Compared with the past two years, however, the labor force in 1928 represents a reduction of almost 5,000 workers.

STATISTICAL SUMMARY

TABLE 1.—*Salient statistics of the coal industry in 1928*

[Figures for bituminous in net tons; anthracite in gross tons]

	Bituminous	Anthracite
Production.....tons..	500,744,970	67,275,062
Value at mines	$933,774,000	$393,638,000
Average value per ton	$1.86	$5.85
Average spot price as quoted by Coal Age	$1.80	(1)
Number of active mines of commercial size	6,450	[2] 299
Stocks of commercial consumers:		
Jan. 1.....tons..	55,500,000	(1)
Dec. 31.....do....	41,800,000	(1)
Net change during year.....do....	13,700,000	(1)
Exports.....do....	16,164,000	2,979,000
Imports.....do....	547,000	343,000
Consumption (calculated).....do....	498,828,000	65,759,000
Capacity of mines with present labor force (assuming 303.5 working days in the anthracite field and 308 working days in the bituminous field).....tons..	760,000,000	94,000,000
Average number of days worked	203	217
Average days idle:		
All causes	105	86.5
Through strikes and lockouts	8	2
Other causes	97	84.5
Average number employed:		
Miners, loaders, and shot firers	329,364	81,627
Haulage and track	61,259	16,183
Other underground	60,337	26,086
Surface	71,190	36,785
Output per man:		
Per day.....tons..	4.73	[3] 2.17
Per year.....do....	959	[3] 469
Number of cutting machines	15,261	193
Quantity cut by machines.....tons..	369,687,007	1,151,615
Per cent of output cut by machines	73.8	1.8
Number of power shovels in strip pits	415	108
Quantity produced by stripping.....tons..	19,788,577	2,163,325

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[1] Data not available. For changes in producer's stocks see Table 3

[2] Number of breakers, washeries, and dredges.

[3] Net tons.

TABLE 2.—*Summary of coal produced, value, men employed, days worked, and output per man per day, by States, 1927 and 1928*

[Note that figures relate only to active mines of commercial size; no canvass of wagon mines was made]

State	Net tons					Value		Number of employees					Average number of days worked	Average tons per man per day
								Underground						
	Loaded at mines for shipment	Sold to local trade and used by employees	Used at mines for power and heat	Made into coke at mines	Total quantity	Total	Average per ton	Miners, loaders, and shot firers	Haulage and track	All others	Surface	Total		
1927														
Alabama	18,880,865	652,158	232,843		19,765,866	$44,524,000	$2.25	16,233	3,383	3,662	4,337	27,615	231	3.10
Alaska	98,042	5,215	1,043		104,300	548,000	5.25	56	10	27	61	154	229	2.96
Arizona		4,583			4,583	6,000	1.31	8				8	156	3.67
Arkansas	1,515,330	15,700	17,804		1,548,834	5,393,000	3.48	2,278	418	347	663	3,706	137	3.05
California, Idaho, Nevada, and Oregon	21,076	4,679	2,086		27,841	85,000	3.05	44	6	18	20	88	208	1.52
Colorado	8,542,965	635,213	226,427	319,470	9,724,075	27,044,000	2.78	7,429	1,352	1,283	1,935	11,999	196	[1] 4.13
Georgia	72,083	552	799	3,278	76,712	233,000	3.04				114	114	250	2.69
Illinois	42,757,667	3,379,701	710,856		46,848,224	101,356,000	2.16	53,798	7,893	8,003	7,276	76,970	114	5.36
Indiana	16,754,142	836,922	344,694		17,935,758	36,381,000	2.03	14,925	2,808	2,594	4,025	24,352	120	6.13
Iowa	2,146,788	746,755	56,079		2,949,622	9,304,000	3.15	6,353	894	838	656	8,741	114	2.96
Kansas	3,028,293	371,473	43,996		3,443,762	9,648,000	2.80	5,054	473	336	1,141	7,004	138	3.57
Kentucky	67,579,996	899,824	487,231	156,947	69,123,998	119,249,000	1.73	39,053	8,271	8,005	9,418	64,747	237	4.50
Maryland	2,693,555	107,315	13,972		2,814,842	5,817,000	2.07	2,254	419	336	450	3,459	220	3.70
Michigan	696,820	6,471	53,472		756,763	3,262,000	4.31	1,085	165	145	117	1,512	188	2.67
Missouri	2,601,107	404,605	58,631		3,064,343	8,698,000	2.84	3,887	381	507	1,457	6,232	151	3.26
Montana	2,963,937	125,175	54,526		3,143,638	7,403,000	2.35	1,366	314	233	368	2,281	197	6.99
New Mexico	2,822,899	49,824	62,816		2,935,539	9,179,000	3.13	2,050	384	410	612	3,456	251	3.38
North Carolina	48,535	4,842			53,377	191,000	3.58	80	21	14	25	140	284	1.34
North Dakota	1,213,171	290,023	24,745		1,527,939	2,604,000	1.70	744	75	56	466	1,341	168	6.78
Ohio	13,144,135	2,439,062	216,500		15,799,697	30,376,000	1.92	24,531	3,290	3,255	4,467	35,543	98	4.52
Oklahoma	3,698,285	66,332	53,437		3,818,054	11,570,000	3.03	3,418	700	493	1,185	5,796	197	3.35
Pennsylvania, bituminous	116,025,187	7,177,039	1,317,478	8,444,935	132,964,639	272,714,000	2.05	101,200	15,878	17,226	19,395	153,699	203	4.26
South Dakota	2,925	9,582			12,507	38,000	3.04	49				49	125	2.04
Tennessee	5,423,133	118,720	55,685	185,829	5,783,367	10,645,000	1.84	4,868	920	811	1,092	7,691	235	3.20
Texas	1,288,209	14,559	23,617		1,326,385	1,998,000	1.51	1,130	157	139	248	1,674	202	3.92
Utah	4,563,803	42,553	32,940	142,184	4,781,480	11,084,000	2.32	1,968	429	326	616	3,339	209	[1] 6.84
Virginia	12,234,331	108,395	50,819	522,497	12,916,042	23,203,000	1.80	6,590	1,915	2,694	2,012	13,211	238	4.11
Washington	2,435,005	106,344	45,760	47,953	2,635,062	9,222,000	3.50	1,967	355	373	712	3,407	210	3.68

[1] Probably too high because of practice, common in some districts, of men going into mines to shoot coal and load mine cars on days when tipples or mines, as a whole, are not in operation.

TABLE 2.—*Summary of coal produced, value, men employed, days worked, and output per man per day, by States, 1927 and 1928*—Continued

State	Net tons					Value		Number of employees					Average number of days worked	Average tons per man per day
								Underground						
	Loaded at mines for shipment	Sold to local trade and used by employees	Used at mines for power and heat	Made into coke at mines	Total quantity	Total	Average per ton	Miners, loaders, and shot firers	Haulage and track	All others	Surface	Total		
1927—Continued														
West Virginia	140,536,113	3,133,188	556,606	896,540	145,122,447	$249,730,000	$1.72	66,585	17,385	17,814	18,015	119,799	235	5.15
Wyoming	6,435,044	133,080	185,532	------------	6,753,656	18,152,000	2.69	3,562	720	580	929	5,791	189	6.18
Total bituminous	480,223,441	21,889,884	4,930,394	10,719,633	517,763,352	1,029,657,000	1.99	372,565	69,016	70,525	81,812	593,918	191	4.55
Pennsylvania anthracite	70,495,286	3,046,770	6,553,508	------------	80,095,564	420,942,000	5.26	82,583	18,186	26,428	38,062	165,259	225	2.15
Grand total	550,718,727	24,936,654	11,483,902	10,719,633	597,858,916	1,450,599,000	2.43	455,148	87,202	96,953	119,874	759,177	199	3.96
1928														
Alabama	16,996,938	433,581	190,843	------------	17,621,362	39,601,000	2.25	15,566	2,992	3,192	3,958	25,708	222	3.09
Alaska	118,440	6,400	1,260	------------	126,100	662,000	5.25	51	10	24	48	133	224	4.23
Arizona	------------	3,600	------------	------------	3,600	16,000	4.44	11	--------	--------	1	12	208	1.45
Arkansas	1,627,550	15,010	18,413	------------	1,660,973	5,615,000	3.38	2,620	432	379	661	4,092	146	2.79
California, Idaho, and Oregon	18,235	4,003	1,650	------------	23,888	70,000	2.93	43	7	16	18	84	177	1.61
Colorado	8,621,540	795,155	196,866	234,146	9,847,707	27,613,000	2.80	7,994	1,463	1,097	1,812	12,366	193	[1] 4.13
Georgia	56,487	596	259	1,048	58,390	181,000	3.10	--------	--------	--------	124	124	280	1.68
Illinois	51,513,409	3,672,205	762,585	------------	55,948,199	112,095,000	2.00	43,718	7,130	6,681	6,737	[2] 64,266	156	[2] 5.57
Indiana	15,488,382	564,930	325,268	------------	16,378,580	29,212,000	1.78	9,967	1,859	1,735	3,245	16,806	150	6.51
Iowa	2,849,348	781,390	52,897	------------	3,683,635	10,525,000	2.86	5,055	766	644	500	6,965	175	3.02
Kansas	2,433,549	335,739	40,436	------------	2,809,724	6,861,000	2.44	4,153	446	261	1,131	5,991	128	3.68
Kentucky	60,454,706	884,996	454,818	65,859	61,860,379	96,722,000	1.56	37,801	7,383	8,460	8,551	62,195	212	4.69
Maryland	2,564,099	111,297	11,583	------------	2,686,979	4,954,000	1.84	2,225	387	311	381	3,304	233	3.50
Michigan	566,587	7,637	43,118	------------	617,342	2,631,000	4.26	818	174	127	120	1,239	187	2.67
Missouri	3,196,405	464,703	71,313	------------	3,732,421	9,637,000	2.58	3,697	421	448	1,398	5,964	180	3.47
Montana	3,169,415	109,930	44,850	------------	3,324,195	7,550,000	2.27	1,319	282	200	390	2,191	191	7.93
New Mexico	2,604,467	50,495	56,889	------------	2,711,851	8,636,000	3.18	2,142	377	319	603	3,441	213	3.70
North Carolina	51,740	5,900	3,220	------------	60,860	201,000	3.30	160	32	16	32	240	180	1.41
North Dakota	1,319,721	311,936	18,273	------------	1,649,930	2,780,000	1.68	803	78	55	399	1,335	177	7.00
Ohio	12,786,442	2,706,600	148,183	------------	15,641,225	26,439,000	1.69	14,151	1,937	2,317	2,966	21,371	171	4.28
Oklahoma	3,343,042	108,339	49,944	------------	3,501,325	10,365,000	2.96	3,796	662	631	1,129	6,218	169	3.34
Pennsylvania, bituminous	117,785,042	7,055,988	1,211,269	5,149,864	131,202,163	249,895,000	1.90	90,036	13,588	13,729	16,061	133,414	218	4.52
South Dakota	663	13,266	------------	------------	13,929	39,000	2.80	41	--------	--------	--------	41	128	2.66
Tennessee	5,279,223	91,880	66,200	173,656	5,610,959	9,694,000	1.73	4,951	930	818	1,150	7,849	226	3.16

Texas	1, 141, 370	21, 087	19, 577		1, 182, 034	1, 589, 000	1. 34	974	161	113	214	1, 462	203	[1] 3. 99
Utah	4, 713, 408	53, 489	26, 534	49, 113	4, 842, 544	12, 253, 000	2. 53	2, 071	417	323	541	3, 352	191	[1] 7. 57
Virginia	11, 371, 792	111, 853	39, 130	378, 158	11, 900, 933	20, 375, 000	1. 71	6, 293	1, 766	2, 445	1, 808	12, 312	226	4. 28
Washington	2, 339, 921	116, 897	33, 730	29, 353	2, 519, 901	8, 720, 000	3. 46	1, 951	284	367	497	3, 099	220	3. 70
West Virginia	128, 671, 064	3, 020, 027	537, 043	724, 025	132, 952, 159	211, 480, 000	1. 59	64, 045	16, 589	15, 197	15, 902	111, 733	223	5. 35
Wyoming	6, 264, 930	130, 695	176, 058		6, 571, 683	17, 363, 000	2. 64	2, 912	686	432	813	4, 843	214	6. 34
Total bituminous	467, 347, 915	21, 989, 624	4, 602, 209	6, 805, 222	500, 744, 970	933, 774, 000	1. 86	329, 364	61, 259	60, 337	71, 190	522, 150	203	4. 73
Pennsylvania anthracite	66, 487, 600	3, 184, 826	5, 675, 643		75, 348, 069	393, 638, 000	5. 22	81, 627	16, 183	26, 086	36, 785	160, 681	217	2. 17
Grand total	533, 835, 515	25, 174, 450	10, 277, 852	6, 805, 222	576, 093, 039	1, 327, 412, 000	2. 30	410, 991	77, 442	86, 423	107, 975	682, 831	206	4. 10

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[1] Probably too high because of practice, common in some districts, of men going into mines to shoot coal and load mine cars on days when tipples or mines, as a whole, are not in operation.

[2] The figure of 5.57 tons per man per day for Illinois is not comparable with earlier years, although computed in exactly the same way. It is obtained by dividing the tonnage produced by the total number of man-days worked, the latter being calculated for each mine by multiplying the average number of men employed by the number of days that the mine worked. This method of calculation is the best one feasible in the light of the records kept by the majority of American coal operators, and the results are generally comparable from year to year. In Illinois during 1928, however, some operators installing mechanical loading for the first time pursued the practice of dividing up the work among the men already on their pay rolls in order to avoid discharging men. For this reason the number of men reported as employed in 1928 (64,266) is considerably in excess of the number actually at work on any one day. Were it possible to allow for this fact, the output per man per day would appear materially higher than 5.57 tons. Even so, it shows a notable increase over the 5.36 tons reported in 1927.

TABLE 3.—*Production, imports, exports, and consumption of anthracite and bituminous coal, 1917–1928, in net tons*

Calendar year	Production	Imports	Exports to—		Net changes in stocks [1]	Consumption in the United States [2]
			Canada and Mexico	Other countries (seaborne)		
Anthracite:						
1917	99,612,000	13,000	5,917,000	90,000	−450.000	94,068,000
1918	98,826,000	37,000	4,910,000	58,000	+1,120,000	92,775,000
1919	88,092,000	83,000	4,871,000	106,000	+1,680,000	81,518,000
1920	89,598,000	32,000	4,987,000	417,000	−1,560,000	85,786,000
1921	90,473,000	9,000	4,569,000	108,000	+3,855,000	81,950,000
1922	54,683,000	234,000	2,579,000	70,000	−4,530,000	56,798,000
1923	93,339,000	300,000	4,993,000	97,000	+1,635,000	86,914,000
1924	87,927,000	118,000	3,932,000	86,000	+3,310,000	80,717,000
1925	61,817,000	383,000	3,098,000	81,000	−5,040,000	64,061,000
1926	84,437,000	814,000	3,947,000	83,000	+4,000,000	77,221,000
1927	80,096,000	119,000	3,248,000	78,000	+2,218,000	74,671,000
1928	75,348,000	385,000	3,298,000	38,000	−1,254,000	73,651,000
Bituminous:						
1917	551,791,000	1,448,000	18,324,000	5,506,000	----------------	529,409,000
1918	579,386,000	1,457,000	18,316,000	4,034,000	+27,900,000	530,593,000
1919	465,860,000	1,012,000	12,064,000	8,050,000	−34,900,000	481,658,000
1920	568,667,000	1,245,000	16,458,000	22,059,000	+22,800,000	508,595,000
1921	415,922,000	1,258,000	13,590,000	9,541,000	+2,200,000	391,849,000
1922	422,268,000	5,060,000	10,938,000	1,475,000	−12,000,000	426,915,000
1923	564,565,000	1,882,000	16,960,000	4,494,000	+26,000,000	518,993,000
1924	483,687,000	417,000	12,746,000	4,354,000	−17,000,000	484,004,000
1925	520,053,000	602,000	13,547,000	3,915,000	+4,000,000	499,193,000
1926	573,367,000	486,000	13,762,000	21,510,000	+6,000,000	532,581,000
1927	517,763,000	550,000	14,724,000	3,288,000	+500,000	499,801,000
1928	500,745,000	547,000	14,050,000	2,114,000	−13,700,000	498,828,000

[1] Anthracite figures are producers' stocks; bituminous, consumers' stocks. Plus sign denotes coal produced but added to stocks and not consumed; minus sign denotes coal consumed that was withdrawn from stocks carried over from preceding year. Anthracite data from Federal Trade Commission cost reports (Coal, No. 2, p. 27) and hearings before Frelinghuysen coal committee, S. Res. 126, 66th Cong., 1st sess. (pt. 1, p. 308). These anthracite figures for 1918 represent coal year, since then calendar years, and are in part estimates. Bituminous data from reports on consumers' stocks of bituminous coal, issued by United States Bureau of Mines, and article in Coal Age, Aug. 26, 1920, p. 429, by C. E. Lesher, formerly coal statistician, United States Geological Survey, and director of statistical division, United States Fuel Administration.

[2] Production tonnage, plus imports and minus exports, plus or minus the decrease or increase, respectively, of the net change in coal stocks.

TABLE 4.—*Salient statistics of the bituminous coal industry in 1913, 1923, and 1925–1928*

	1913	1923	1925	1926	1927	1928
Production:						
Loaded at mines for shipment ... net tons	403, 434, 246	505, 859, 295	477, 172, 812	526, 285, 997	480, 223, 441	467, 347, 915
Sold to local trade and used by employees ... do	13, 871, 828	22, 081, 040	21, 351, 223	23, 601, 587	21, 889, 884	21, 989, 624
Used at mines for power and heat ... do	11, 670, 903	8, 765, 011	5, 776, 103	5, 727, 852	4, 930, 394	4, 602, 209
Made into coke at mines ... do	49, 458, 320	27, 859, 316	15, 752, 603	17, 751, 549	10, 719, 633	6, 805, 222
Total ... do	478, 435, 297	564, 564, 662	520, 052, 741	573, 366, 985	517, 763, 352	500, 744, 970
Value at mines (total)	$565, 235, 000	$1, 514, 621, 000	$1, 060, 402, 000	$1, 183, 412, 000	$1, 029, 657, 000	$933, 774, 000
Average sales realization per ton	$1. 18	$2. 68	$2. 04	$2. 06	$1. 99	$1. 86
Average spot price, as quoted by Coal Age	$1. 23	$2. 77	$2. 06	$2. 21	$1. 99	$1. 80
Number of active mines of commercial size:						
Class 1A (producing 500,000 tons or more)	694	748	145	174	132	152
Class 1B (producing 200,000 to 500,000 tons)			569	649	647	621
Class 2 (producing 100,000 to 200,000 tons)	837	935	833	845	818	687
Class 3 (producing 50,000 to 100,000 tons)	959	1, 176	891	867	879	725
Class 4 (producing 10,000 to 50,000 tons)	1, 558	2, 742	1, 969	1, 912	1, 831	1, 513
Class 5 (producing less than 10,000 tons)	1, 728	3, 730	2, 737	2, 730	2, 704	2, 752
Total	5, 776	9, 331	7, 144	7, 177	7, 011	6, 450
Per cent of output from mines in classes 1A, 1B, and 2	75. 4	70. 4	76. 4	79. 1	77. 1	80. 1
Exports to Canada ... net tons	15, 115, 733	16, 854, 257	13, 421, 007	13, 633, 513	14, 594, 297	13, 958, 961
Exports overseas and all other ... do	5, 029, 435	4, 599, 322	4, 040, 553	21, 638, 424	3, 417, 447	2, 205, 524
Imports ... do	1, 583, 520	1, 882, 306	601, 737	485, 666	549, 843	546, 526
Consumption (calculated) ... do	459, 874, 000	518, 993, 000	499, 193, 000	532, 581, 000	499, 801, 000	498, 828, 000
Capacity of mines with existing labor force, assuming 308 working days a year ... net tons	635, 000, 000	970, 000, 000	822, 000, 000	821, 000, 000	835, 000, 000	760, 000, 000
Average number of days worked	232	179	195	215	191	203
Average number of days idle	76	129	113	93	117	105
Average number of men employed at mines in operation:						
Miners, loaders, and shot firers	[1] 494, 238	422, 040	367, 456	370, 292	372, 565	329, 364
Other underground		178, 265	139, 085	140, 532	139, 541	121, 596
Surface	[1] 77, 644	104, 488	81, 952	82, 823	81, 812	71, 190
Total	571, 882	704, 793	588, 493	593, 647	593, 918	522, 150
Output per man per day ... net tons	3. 61	4. 47	4. 52	4. 50	4. 55	4. 73
Output per man per year ... do	837	801	884	966	872	959
Per cent of output cut by machine	50. 7	66. 9	70. 6	71. 7	72. 2	73. 8
Number of power shovels in strip pits	[2] 48	442	389	410	455	415
Quantity produced by stripping ... net tons	[2] 1, 280, 946	11, 844, 347	16, 870, 907	16, 922, 695	18, 378, 166	19, 788, 577

[1] Estimate.

[2] Figures are for 1914, the year of earliest record.

METHODS OF COLLECTING THE STATISTICS

VOLUNTARY COOPERATION

The principal statistics for each State for 1927 and 1928 are given in Table 2. These statistics are obtained from the producers' written reports, most of them signed by officers of the companies that furnish the figures. The reports are collected by correspondence which is supplemented by visits of field agents if correspondence has failed. The Bureau of Mines has no power to compel the filing of reports.

Under this system accurate results can be obtained only by the generous cooperation of the producers in furnishing returns voluntarily. The operators generally respond cordially to the bureau's questionnaires, with which they have become familiar through more than 40 years of contact and cooperation, so that a very large percentage of the returns is obtained by mail, leaving relatively few reports to be obtained by personal visits.

COMPLETENESS OF THE RETURNS

Commercial mines and wagon mines.—A complete count of the thousands of wagon mines and country coal banks from which bituminous coal is dug in the United States could be made only by sending agents up every creek and along every hillside in the coal-bearing regions. The cost of such a count would prohibit it, and in practice a limit must be set to the size of the mines to be considered. The Federal Census Bureau set this limit at mines producing about 1,000 tons a year for the last decennial census of mines and quarries, taken in 1920. Many of the States that publish statistics set the limit higher. The Pennsylvania Department of Mines, for example, covers only enterprises employing as many as 10 men.

The Bureau of Mines desires to ascertain the total output of coal from all sources, large or small, in order to find the rate at which the country's resources are being drawn upon. In practice, however, it has been found advisable to employ different methods for the commercial mines, on the one hand, and the wagon mines, on the other.

The line between commercial mines and small workings, however, is difficult to draw. Mere size of output is not a criterion, for some wagon mines ship rather large quantities of coal. Absence of a railroad switch is not a criterion, for this would exclude from the commercial class some large mines that ship by river or truck or that deliver their product to associated industries at the mouth of the mine.

In practice, the Bureau of Mines has found a safer criterion to be size in conjunction with steady operation. All mines that produce 10,000 tons or more a year are classed by the bureau as commercial mines, but the commercial class also includes much smaller mines, some of which have an annual output of hardly 1,000 tons, but produce year after year and show a fairly continuous existence.

These smaller properties sometimes ship by rail but oftener serve a local market by wagon or truck or supply a local manufacturing plant near the tipple. There are many hundreds of such small operations that continue to contribute to the supply of coal year after year, and the bureau endeavors to include them in its lists of commercial producers. A mine may be shifted from the list of commercial mines to the list of wagon mines, or vice versa, as the course of the work at the mine may make such a shift advisable.

Method of obtaining data on commercial mines.—For the commercial mines statistics can be obtained largely by correspondence. To the mailing list new names are constantly being added from the trade journals, from the records of State mine inspectors, from reports of field agents, and from reports by the producers themselves. At intervals the list is checked against lists kept by associations of operators or State officials and lists of shippers kept by railroad car distributors.

Schedules of inquiry are mailed by the Bureau of Mines to all producing companies listed, and no company is dropped from the list until it has been definitely accounted for. To follow up companies from which no reply is received by correspondence, cooperative arrangements have been made with State geologists and coal-mine inspectors, secretaries of operators' associations, and other local agents, who make inquiry in person and report to Washington. In the Western States the work of following up the returns is aided by the Branch offices maintained by the Bureau of Mines at Joplin, Denver, Salt Lake City, and San Francisco. Areas to which no permanent local representative of the bureau has been assigned can be covered only by sending out field agents from Washington, and the present plans include regular work by such agents every year.

Some of the mines are operated so intermittently that the owners can not be found at the end of the year, and recourse must be had to railroads to find the number of tons of coal shipped by these mines, from which estimates can be made of the number of men employed and the value of the product. Such estimates are made in order to round out totals, but only when the evidence shows that a mine was in operation during the year and when all other means of getting the exact figures have failed. Wherever in this report the inclusion of estimates introduces the probability of significant error, that fact is indicated.

Method of obtaining data on wagon mines.—The method just described has yielded satisfactory figures for the operation of mines on the list of commercial producers. To handle the sporadic wagon mines, "fly-by-nights," and "snowbirds" that appear, mushroom-like, at times of shortage and high prices, requires a different method. All these workings are referred to by the bureau as wagon mines, the term in common usage that most nearly describes them. Where these wagon mines are within reach of a railroad and are therefore able to demand railroad cars for shipment of their product, they may have a material influence on the car supply, on the spot price, on the rate of wages, and on the prevailing quality of coal, an influence out of all proportion to the actual tonnages they ship. In 1920, for example, there were more than 4,000 such wagon mines in operation, all demanding railroad cars, and they shipped by rail about 4,500,000 tons of bituminous coal. They are chiefly important in the Appalachians, where coal outcrops abundantly along many of the railroads and surfaced highways. Under such conditions coal can be dug with almost no capital investment. The labor cost at wagon mines is high. Such workings can compete only in periods of high prices but can open or close without thought of fixed charges, depreciation, and maintenance; their only consideration is the price of coal on the spot market.

When coal prices are high the wagon mines are important enough to be included in the statistics, but how to obtain complete information about them is a problem. After experimenting with various methods the bureau has found that the only feasible plan is to ask each railroad for a list of the wagon mines on its lines that shipped coal during the year and for the number of cars shipped by each. Such information was generously furnished by the railroads in 1920, 1922, and 1923 and gave virtually complete information as to the number, location, and output of the wagon mines that shipped by rail in those years.

On the other hand, when the price is low, wagon mines close as suddenly as they open and disappear as a factor in the trade; therefore, in 1921, and from 1924 to 1928 no attempt was made to get information on the output of these mines. Statistics for these years relate to the commercial mines exclusively. It is not to be inferred, however, that the figures given are incomplete. A complete count of all the wagon mines shipping by rail would have added only a few thousand tons to the totals in this report.

Data on labor in wagon mines.—No reports on the number of employees or time worked have ever been obtained from the wagon mines, and in this report all the statistics on men employed, days worked, output per man, and the like for the years in which the tonnage of wagon mines was covered are calculated from the returns of the commercial mines alone.

Omission of country coal banks.—The methods outlined above are believed to yield virtually complete returns for all mines, big and little, that ship by rail or water and for all those of commercial size that serve a purely local market. The data herein do not cover the tiny workings that produce less than 1,000 tons a year and are situated at points remote from a railroad—workings that can best be described as country coal banks. Little openings of this kind, where one or two men dig a few hundred bushels for sale in the neighborhood or farmers come with their wagons and trucks to dig their own fuel, are common in regions where coal outcrops. Although their number runs into the thousands, their combined output is so small as to be negligible; their product does not involve the use of railroad cars and does not compete with the output of commercial mines. When in the past the attempt was made to obtain data on these coal banks regularly, the maximum total output reported for them was about 1,000,000 tons a year, a quantity too small to justify the cost of collecting the information.

UNITS OF MEASUREMENT

The standard unit of measurement adopted for this report is the net or short ton of 2,000 pounds, but as Pennsylvania anthracite is mined and sold by the gross or long ton of 2,240 pounds that unit is used in the section of the report dealing with anthracite. Unless the unit is otherwise expressly stated, the word "ton" as here used means the net ton of 2,000 pounds, to which all other figures, however reported, have been converted.

There is a steadily growing sentiment in favor of the general use of the net ton of 2,000 pounds as the standard unit of the coal trade, particularly for bituminous coal in the Eastern States, where both gross and net tons are now used. The use of both units is, of course, undesirable, but as some State and municipal laws require the use of the gross ton and as freight rates throughout a part of the Eastern States are now fixed accordingly it is difficult to make an immediate change to a standard unit. In reports on foreign trade and shipping rates quantities are expressed in either gross or metric tons, and here, too, the use of more than one unit is undesirable. The general use of the net ton in the United States, even in the anthracite region, is here recommended.

ANTHRACITE, BITUMINOUS COAL, AND LIGNITE

Two industries.—In the statistical reports of the Bureau of Mines the anthracite industry of Pennsylvania and the bituminous-coal industry are listed separately. Both produce coal, and between them there is a certain degree of competition, especially in the sale of the anthracite steam sizes, but the differences in corporate organization, in railroad relations, in geographic position, in natural conditions of mining, in marketing practices, in methods of preparing the coal for the market, and in the nature of the demand are so pronounced that they require separate treatment.

Pennsylvania anthracite industry.—The Pennsylvania anthracite industry, as understood in the trade and as used in this report, is confined to a narrow area of 480 square miles in eastern Pennsylvania. It includes the familiar Lehigh, Schuylkill, and Wyoming regions and also the little outlying Bernice Basin in Sullivan County. In this sharply restricted region are concentrated mines that employed 161,000 men and produced 75,348,000 net tons of coal in 1928.

Hard coal mined outside of Pennsylvania.—The statistics of the bituminous-coal industry published in this and in preceding reports include tonnages of hard coal mined outside of Pennsylvania. Such coals are commercially produced in the Crested Butte field of Colorado, in the Los Cerrillos area of New Mexico, in the Spadra and Russellville districts of Arkansas, and in that portion of the Valley Coal Fields of Virginia lying in Montgomery and Pulaski Counties. In no way are the operations in these areas connected with the close-knit anthracite industry of Pennsylvania. On the contrary, they are affiliated most closely with the bituminous industry in their respective States regarding railroad connections, marketing problems, labor relations, and even in ownership and management. Moreover, because the commercial developments are widely scattered and because there are differences in operating and marketing problems among the four principal areas there is no recognizable unity or community of interests among the hard-coal districts outside of Pennsylvania. They have therefore been included with the bituminous operations of their respective States in the statistical record.

However, in view of the growing tonnage of hard coal mined outside of Pennsylvania and the present general interest in all fuels available for househeating—to which this coal is admirably adapted—special attention is given to the statistics covering the hard-coal output of Arkansas, Colorado, New Mexico, and Virginia on pages 557 to 569 of this report. From the record it will be seen that the total production increased from 363,324 tons in 1913 to 712,406 tons in 1928. (See fig. 25.)

Lignite.—The statistics of the bituminous-coal industry published in this report include lignite. In the classification of coals adopted by the United States Geological Survey the "black lignites" mined in the far West are termed "subbituminous coals." True lignite, although occurring in enormous amounts in the northern Great Plains and Gulf coast geological provinces, is as yet little mined in the United States. The production in 1928 was about 2,782,000 tons, of which 1,650,000 was mined in North Dakota, 14,000 in South Dakota, 54,000 in eastern Montana, and 1,064,000 in the lignite area of Texas. Although the producers of this coal have certain problems in common they do not form a separate national interest as do the producers in the brown-coal industry of Germany. Their system of mining resembles that used by the producers of bituminous coal. At present the statistics on lignite can best be combined with those for the bituminous-coal industry.

GROWTH OF THE INDUSTRY

HISTORICAL SUMMARY

TABLE 5.—*Growth of the bituminous coal-mining industry, 1890–1928*

Year	Production (millions of net tons)	Value (millions of dollars)	Men employed (thousands)	Calculated capacity (millions of net tons)		Average number of days worked	Average number of days lost on account of—			Value per ton	Net tons per man		Per cent cut by machine	Mined by stripping (millions of net tons)[1]
				At 308 days	At 280 days		Strikes	Other causes	Total lost		Per day	Per year		
1890	111	110	192	152	137	226	(2)	(2)	82	$0.99	2.56	579	(2)	(2)
1891	118	117	206	163	148	223	(2)	(2)	85	.99	2.57	573	5.3	(2)
1892	127	125	213	178	162	219	(2)	(2)	89	.99	2.72	596	(2)	(2)
1893	128	123	230	194	174	204	(2)	(2)	104	.96	2.73	557	(2)	(2)
1894	119	108	245	214	196	171	(2)	(2)	137	.91	2.84	486	(2)	(2)
1895	135	116	240	215	196	194	(2)	(2)	114	.86	2.90	563	(2)	(2)
1896	138	115	244	221	202	192	(2)	(3)	116	.83	2.94	564	11.9	(2)
1897	148	120	248	232	213	196	(2)	(2)	112	.81	3.04	596	15.3	(2)
1898	167	133	256	243	221	211	(2)	(2)	97	.80	3.09	651	19.5	(2)
1899	193	168	271	254	230	234	8	66	74	.87	3.05	713	22.7	(2)
1900	212	221	304	279	255	234	5	69	74	1.04	2.98	697	24.9	(2)
1901	226	236	340	309	281	225	2	81	83	1.05	2.94	664	25.6	(2)
1902	260	291	370	348	316	230	7	71	78	1.12	3.06	703	26.8	(2)
1903	283	352	416	387	350	225	3	80	83	1.24	3.02	680	27.6	(2)
1904	279	306	438	425	386	202	8	98	106	1.10	3.15	637	28.2	(2)
1905	315	335	461	460	417	211	2	95	97	1.06	3.24	684	32.8	(2)
1906	343	381	478	496	451	213	28	67	95	1.11	3.36	717	34.7	(2)
1907	395	451	513	520	473	234	1	73	74	1.14	3.29	769	35.1	(2)
1908	333	374	516	531	482	193	11	104	115	1.12	3.34	644	37.0	(2)
1909	380	405	543	560	510	209	1	98	99	1.07	(2)	(2)	37.5	(2)
1910	417	469	556	592	538	217	35	56	91	1.12	3.46	751	41.7	(2)
1911	406	451	550	593	538	211	2	95	97	1.11	3.50	738	43.9	(2)
1912	450	518	549	622	566	223	10	75	85	1.15	3.68	820	46.8	(2)
1913	478	565	572	635	577	232	5	71	76	1.18	3.61	837	50.7	(2)
1914	423	493	584	668	608	195	19	94	113	1.17	3.71	724	51.7	1.3
1915	443	502	557	672	610	203	4	101	105	1.13	3.91	794	55.0	2.8
1916	503	665	561	673	613	230	4	74	78	1.32	3.90	896	56.5	3.9
1917	552	1,249	603	699	636	243	4	61	65	2.26	3.77	915	55.5	5.8
1918	579	1,492	615	717	650	249	1	58	59	2.58	3.78	942	55.9	8.3
1919	466	1,161	622	736	669	195	25	88	113	2.49	3.84	749	59.2	5.6
1920	569	2,130	640	796	725	220	6	82	88	3.75	4.00	881	59.8	8.9
1921	416	1,200	664	860	781	149	3	156	159	2.89	4.20	627	65.6	4.7
1922	422	1,275	688	916	832	142	78	88	166	3.02	4.28	609	63.2	9.9
1923	565	1,515	705	970	885	179	2	127	129	2.68	4.47	801	66.9	11.8
1924	484	1,063	620	871	792	171	7	130	137	2.20	4.56	781	69.5	13.6
1925	520	1,060	588	822	748	195	2	111	113	2.04	4.52	884	70.6	16.9
1926	573	1,183	594	821	747	215	1	92	93	2.06	4.50	966	71.7	16.9
1927	518	1,030	594	835	759	191	45	72	117	1.99	4.55	872	72.2	18.4
1928	501	934	522	760	691	203	8	97	105	1.86	4.73	959	73.8	19.8

[1] See footnote 1, Table 34.

[2] No data.

TABLE 6.—*Growth of the anthracite-mining industry, 1890–1928*

Year	Production (millions of gross tons)	Value (millions of dollars)	Employees (thousands)	Calculated capacity at 304 days (millions of gross tons)	Average number of days worked	Net tons per man		Washery and dredge shipments (millions of gross tons)	Per cent of shipments that were domestic sizes (excluding pea) [1]	Per cent of total shipments that came from [2]—		
						Per day	Per year			Lehigh region	Schuylkill region	Wyoming region
1890	41	66	126	63	200	1.85	369	(3)	76.9	17.3	29.7	53.0
1891	45	74	126	68	203	1.98	401	0.1	75.7	15.8	31.5	52.7
1892	47	82	129	72	198	2.06	407	.1	76.0	15.4	30.1	54.5
1893	48	86	133	74	197	2.06	406	.2	74.9	16.0	28.7	55.3
1894	46	78	132	74	190	2.08	395	.6	73.7	16.2	29.1	54.7
1895	52	82	143	80	196	2.07	406	1.1	69.9	15.7	30.7	53.6
1896	49	82	149	85	174	2.10	365	.9	70.3	15.0	30.4	54 6
1897	47	79	150	95	150	2.34	351	1.0	68.5	15.0	29.3	55.7
1898	48	75	146	95	152	2.41	367	1.1	67.3	14.9	28.8	56.3
1899	54	88	140	95	173	2.50	433	1.4	66.1	14.4	29.8	55.8
1900	51	86	144	94	166	2.40	398	2.1	64.7	15.3	30.0	54.7
1901	60	113	145	93	196	2.37	464	2.6	64.2	13.5	29.9	56.6
1902	37	76	148	97	116	2.40	279	2.0	61.0	11.1	27.2	61.7
1903	67	152	150	98	206	2.41	496	3.6	63.6	12.1	27.7	60.2
1904	65	139	156	99	200	2.35	469	2.8	62.0	12.4	28.5	59.1
1905	69	142	165	98	215	2.18	470	2.6	60.9	12.8	28.8	58.4
1906	64	132	162	99	195	2.25	439	3.8	59.1	12.6	28.8	58.6
1907	76	164	167	106	220	2.33	512	4.3	58.6	12.4	30.0	57.6
1908	74	158	174	113	200	2.39	478	3.6	59.3	12.0	27.9	60.1
1909	72	149	(4)	107	205	(4)	(4)	3.7	58.3	12.2	27.2	60.6
1910	75	161	169	100	229	2.17	498	3.3	58.6	13.3	27.5	59.2
1911	81	175	173	100	246	2.13	524	3.2	59.4	13.9	27.4	58.7
1912	75	178	174	99	231	2.10	485	3.2	60.8	13.6	28.2	58.2
1913	82	195	176	97	257	2.02	520	2.1	61.7	14.4	27.4	58.2
1914	81	188	180	101	245	2.06	505	1.7	61.4	14.7	26.3	59.0
1915	79	185	177	105	230	2.19	504	2.5	60.1	14.9	26.5	58.6
1916	78	202	160	94	253	2.16	548	3.1	60.5	14.1	29.3	56.6
1917	[5] 89	284	154	95	285	[5] 2.27	[5] 646	5.4	61.0	14.9	28.6	56.5
1918	[5] 88	336	147	92	293	[5] 2.29	[5] 672	6.6	60.1	15.1	28.9	56.0
1919	79	365	155	90	266	2.14	570	3.3	64.2	15.5	28.5	56.0
1920	[5] 80	434	145	90	271	[5] 2.28	[5] 618	5.0	63.1	14.6	30.4	55.0
1921	81	452	160	91	271	2.09	567	1.6	66.5	13.5	28.9	57.6
1922	[5] 49	274	157	98	151	[5] 2.31	[5] 349	3.2	62.9	13.9	31.8	54.3
1923	83	507	158	95	268	2.21	592	4.1	63.7	13.9	30.4	55.7
1924	79	477	160	87	274	2.00	550	1.4	65.3	13.5	28.5	58.0
1925	55	328	160	92	182	2.12	386	1.4	66.4	14.0	29.1	56.9
1926	75	474	165	94	244	2.09	511	1.4	66.7	14.0	28.3	57.7
1927	72	421	165	96	225	2.15	485	1.8	63.3	14.0	30.0	56.0
1928	67	394	161	94	217	2.17	469	1.7	61.8	13.4	30.5	56.1

[1] Excludes Sullivan County and dredge coal.
[2] Includes dredge shipments, 1914–1928.
[3] Less than one-tenth million tons.
[4] No data.
[5] Years of heavy washery output.

RELATIVE RATE OF GROWTH OF COAL AND OTHER SOURCES OF POWER

Bituminous coal remains the principal source of the energy supply of the United States. In 1928, however, coal production was below the war-time maximum, while on the other hand the production of oil, natural gas, and water power has increased enormously since the war. (See fig. 12.) Tables 7 to 9 bring out the differences in relative growth of the principal sources of energy.

To compare the several sources of energy it is necessary to reduce them to a common denominator, as is done in Table 7, which shows the energy equivalent in British thermal units of each of the fuels. Water power is represented by the equivalent of the fuel necessary to perform the same work. The total of the energy from all sources is given in the last column of the table. For 1928 it amounts to 24,685 trillion B. t. u., which is second only to 1926 and 1927 as the greatest in the history of the country. Thus, while the consumption of coal has not advanced since the war, the total consumption of energy has increased.

The fact should be noted that the figures for "domestic oil" represent the entire production of crude petroleum. Thus they not only include energy used in the form of fuel oil under boilers and therefore competing more or less directly with coal but also that used as gasoline, kerosene, and other refined products. Even these refined products involve a measure of indirect competition with coal, for the energy market of the country is becoming more and more fluid and competitive, and a demand that can not be met by one source of supply tends to fall back on the others. The purpose of these tables is to measure the total demand for energy.

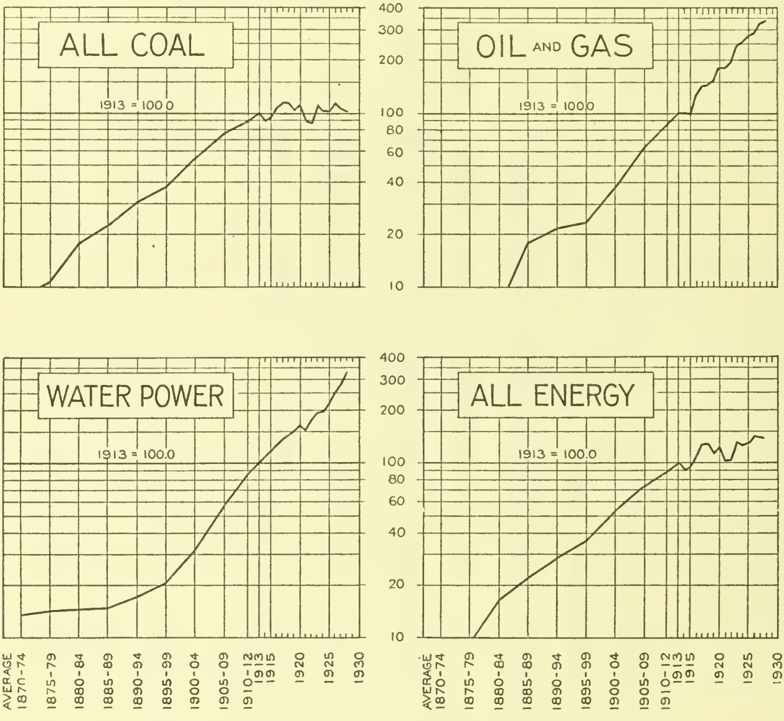

FIGURE 12.—Relative rate of growth of annual supply of coal, oil and gas, and water power in the United States, 1870–1928

TABLE 7.—*Annual supply of energy from mineral fuels and water power in the United States, 1819–1928*

[Figures represent trillions of British thermal units and because of rounding do not always add across exactly. Water power is represented by British thermal units of coal necessary to produce the same amount of power. Figures represent production except those for oil imports and take no account of changes of stock]

Year	Anthracite	Bituminous coal	Total coal	Domestic oil	Natural gas	Imported oil	Total oil and gas	Total mineral fuels	Water power	Grand total, including water power
1819	(1)	--------	(1)	--------	--------	--------	--------	(1)	(2)	(2)
1829	4	3	6	--------	--------	--------	--------	6	(2)	(2)
1839	27	41	68	--------	--------	--------	--------	68	(2)	(2)
1849	109	64	173	--------	--------	--------	--------	173	(2)	(2)
1859	262	158	419	(1)	--------	--------	--------	419	(2)	(2)
1869	464	415	879	25	--------	--------	25	904	(2)	(2)
1879	822	993	1,815	119	(1)	--------	119	1,934	(2)	(2)
1889	1,239	2,507	3,746	211	[3] 268	--------	479	4,225	91	4,316
1899	1,643	5,065	6,708	342	[3] 240	--------	582	7,291	135	7,426
1909	2,205	9,949	12,155	1,099	517	(4)	1,616	13,771	411	14,182
1913	2,490	12,535	15,025	1,491	626	102	2,219	17,243	588	17,831
1918	2,688	15,180	17,868	2,136	775	226	3,137	21,005	837	21,842
1919	2,396	12,206	14,602	2,270	802	317	3,389	17,991	892	18,883
1920	2,437	14,899	17,336	2,658	858	637	4,153	21,489	971	22,460
1921	2,461	10,897	13,358	2,833	712	752	4,297	17,655	908	18,563
1922	1,487	11,063	12,551	3,345	820	764	4,929	17,480	1,024	18,504
1923	2,539	14,791	17,330	4,394	1,082	492	5,968	23,298	1,136	24,434
1924	2,392	12,672	15,064	4,284	1,227	467	5,978	21,042	1,167	22,209
1925	1,681	13,625	15,306	4,582	1,278	371	6,231	21,537	1,290	22,827
1926	2,297	15,022	17,319	4,625	1,411	362	6,398	23,717	1,492	25,209
1927	2,179	13,565	15,744	5,407	1,553	350	7,310	23,054	1,687	24,741
1928	2,049	13,120	15,169	5,409	1,686	479	7,574	22,743	1,942	24,685

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[1] Less than 0.5.

[2] No figures for water power are available before 1889. The fuel equivalent for water power is calculated from the reported horsepower of installed water wheels, assuming a capacity factor of 20 per cent for manufactures and mines and of 40 per cent for public utilities and assuming that the theoretical thermal equivalent of 1 horsepower-hour (2,547 British thermal units) is 7 per cent of the British thermal units that would have been consumed in generating 1 horsepower-hour from fuels in practice. For 1919 to 1928, however, actual reports of the horsepower-hours produced by water in electric utility plants, as recorded by the U. S. Geological Survey, have been used.

[3] Based on the amount of coal displaced by gas, as estimated by the gas companies at the time.

[4] Imports negligible before 1913.

TABLE 8.—*Relative rates of growth of coal, oil, and water power in the United States, 1819–1928*

[The figures for 1918 are represented by the number 100, and the figures for all other years are expressed as a percentage of the 1918 rate]

Year	Anthracite	Bituminous coal	Total coal	Domestic oil	Natural gas	Imported oil	Total oil and gas	Total mineral fuels	Water power	Grand total, including water power
1819	(1)	--------	(1)	--------	--------	--------	--------	(1)	(2)	(2)
1829	(1)	(1)	(1)	--------	--------	--------	--------	(1)	(2)	(2)
1839	1	(1)	(1)	--------	--------	--------	--------	(1)	(2)	(2)
1849	4	(1)	1	--------	--------	--------	--------	1	(2)	(2)
1859	10	1	2	(1)	--------	--------	(1)	2	(2)	(2)
1869	17	3	5	1	--------	--------	1	4	(2)	(2)
1879	31	6	10	6	(1)	--------	4	9	(2)	(2)
1889	46	17	21	10	35	--------	15	20	11	20
1899	61	33	37	16	31	--------	19	35	16	34
1909	82	66	68	51	67	(3)	52	66	49	65
1913	93	83	84	70	81	45	71	82	70	82
1918	100	100	100	100	100	100	100	100	100	100
1919	89	80	81	106	103	140	108	86	107	86
1920	91	98	97	124	111	282	132	102	116	103
1921	92	72	74	132	92	333	137	84	109	85
1922	55	73	70	156	106	338	157	83	122	85
1923	94	97	97	206	140	218	191	111	136	112
1924	89	83	84	201	158	207	191	100	139	102
1925	63	90	86	215	165	164	199	103	154	105
1926	85	99	97	217	182	160	204	113	178	115
1927	81	89	88	253	201	155	233	110	202	113
1928	76	86	85	253	218	212	241	108	232	113

[1] Less than 0.5. [2] No data for water power prior to 1889. [3] Imports negligible prior to 1913.

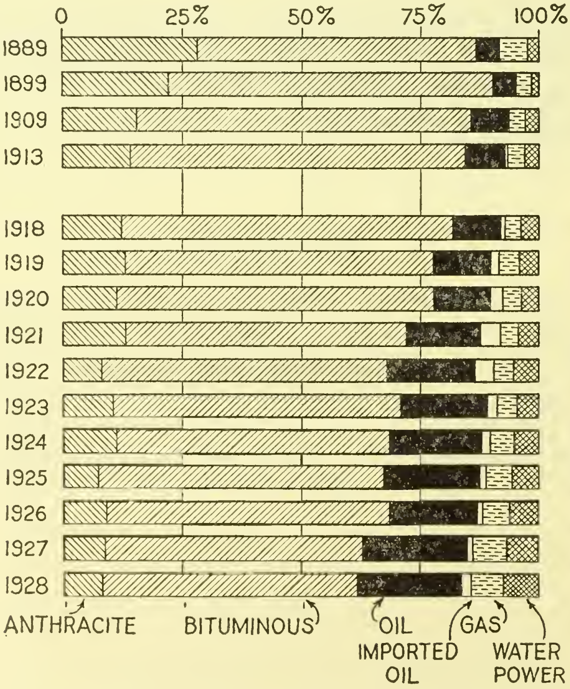

FIGURE 13.—Per cent of the energy supply of the United States derived from coal, oil and gas, and water power, 1889–1928

To make comparison easier the figures of heat units are reduced to index numbers in Table 8, with the year 1918 taken as 100. The production of bituminous coal is seen to be 14 per cent less in 1928 than in 1918. The production of all coal was 15 per cent less than in 1918. On the contrary, the production of oil was 153 per cent and the production of natural gas 118 per cent greater. Meanwhile, imports of oil increased 112 per cent, and the total supply of energy in the form of oil and gas from all sources increased 141 per cent over 1918. In the same period water power increased 132 per cent. The total production of energy in 1928 was 13 per cent above that of 1918.

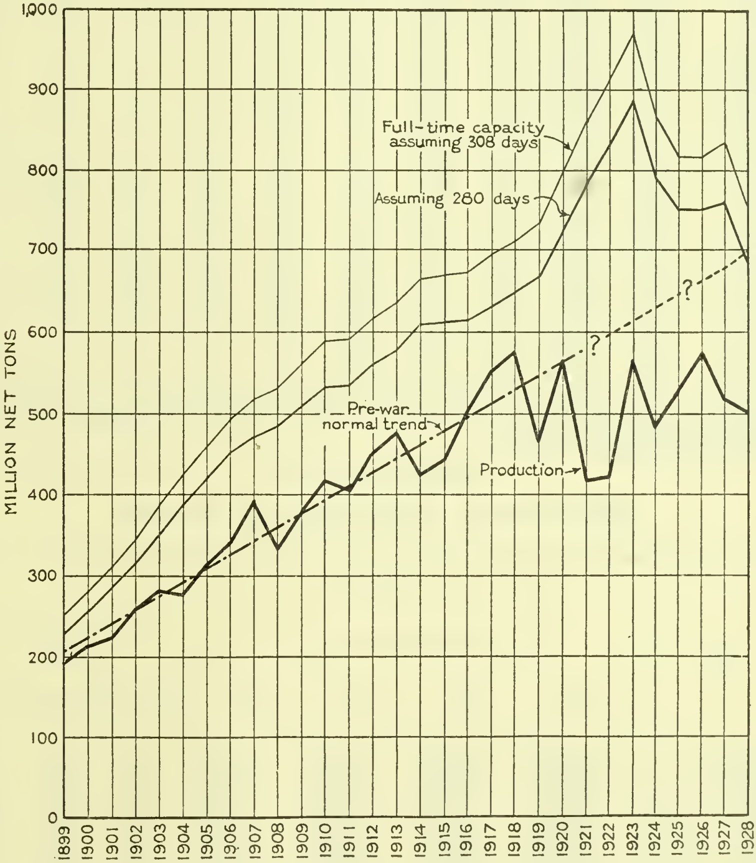

FIGURE 14.—Trend of bituminous coal production and of mine capacity in the United States, 1899–1928

Of the total energy in the mineral fuels in 1928 coal supplied 66.7 per cent and oil and gas 33.3 per cent. The water power developed was equivalent to only 8.5 per cent of the fuel total. (See fig. 13.) Details are given in Table 9.

TABLE 9.—*Per cent of total heating value contributed by the several mineral fuels in the United States, 1819–1928*

Year	Anthracite	Bituminous coal	Total coal	Domestic oil	Natural gas	Imported oil	Total oil and gas	Grand total fuels	Water power, per cent of fuels [1]
1819	100.0	--------	100.0	--------	--------	--------	--------	100.0	(1)
1829	58.4	41.6	100.0	--------	--------	--------	--------	100.0	(1)
1839	40.2	59.8	100.0	--------	--------	--------	--------	100.0	(1)
1849	62.8	37.2	100.0	--------	--------	--------	--------	100.0	(1)
1859	62.3	37.7	100.0	(2)	--------	--------	--------	100.0	(1)
1869	51.3	45.9	97.2	2.8	(2)	--------	2.8	100.0	(1)
1879	42.5	51.3	93.8	6.2	(2)	--------	6.2	100.0	(1)
1889	29.3	59.3	88.6	5.0	6.4	--------	11.4	100.0	2.2
1899	22.5	69.5	92.0	4.7	3.3	--------	8.0	100.0	1.9
1909	16.0	72.2	88.2	8.0	3.8	(2)	11.8	100.0	3.0
1913	14.4	72.7	87.1	8.7	3.6	0.6	12.9	100.0	3.4
1918	12.8	72.3	85.1	10.1	3.7	1.1	14.9	100.0	4.0
1919	13.3	67.9	81.2	12.6	4.5	1.7	18.8	100.0	5.0
1920	11.4	69.3	80.7	12.4	4.0	2.9	19.3	100.0	5.0
1921	14.0	61.7	75.7	16.0	4.0	4.3	24.3	100.0	5.1
1922	8.5	63.3	71.8	19.1	4.7	4.4	28.2	100.0	5.9
1923	10.9	63.5	74.4	18.9	4.6	2.1	25.6	100.0	4.9
1924	11.4	60.2	71.6	20.4	5.8	2.2	28.4	100.0	5.5
1925	7.8	63.3	71.1	21.3	5.9	1.7	28.9	100.0	6.0
1926	9.7	63.3	73.0	19.5	6.0	1.5	27.0	100.0	6.3
1927	9.5	58.8	68.3	23.5	6.7	1.5	31.7	100.0	7.3
1928	9.0	57.7	66.7	23.8	7.4	2.1	33.3	100.0	8.5

[1] No figures for water power are available before 1889; hence to make the figures comparable the data for water power thereafter are expressed as per cent of the fuel total but are not included in the base on which the percentages are computed.

[2] Less than 0.1 per cent.

PRODUCTION

PRODUCTION SUMMARIES, BY STATES

TABLE 10.—*Comparison of bituminous coal produced, by States, 1913, 1923, 1927, and 1928*

State	Production (net tons)				Per cent of increase or decrease		
	1913	1923	1927	1928	1913–1928	1923–1928	1927–1928
Alabama	17,678,522	20,457,649	19,765,866	17,621,362	−3.2	−13.9	−10.8
Arkansas	2,234,107	1,296,892	1,548,834	1,660,973	−25.7	+28.1	+7.2
Colorado	9,232,510	10,346,218	9,724,075	9,847,707	+6.7	−4.8	+1.3
Georgia	255,626	75,620	76,712	58,390	−77.2	−22.8	−23.9
Illinois	61,618,744	79,310,075	46,848,224	55,948,199	−9.2	−29.5	+19.4
Indiana	17,165,671	26,229,099	17,935,758	16,378,580	−4.6	−37.6	−8.7
Iowa	7,525,936	5,710,735	2,949,622	3,683,635	−51.1	−35.5	+24.9
Kansas	7,202,210	4,443,149	3,443,762	2,809,724	−61.0	−36.8	−18.4
Kentucky	19,616,600	44,777,317	69,123,998	61,860,379	+215.3	+38.2	−10.5
Maryland	4,779,839	2,285,926	2,814,842	2,686,979	−43.8	+17.5	−4.5
Michigan	1,231,786	1,172,075	756,763	617,342	−49.9	−47.3	−18.4
Missouri	4,318,125	3,403,151	3,064,343	3,732,421	−13.6	+9.7	+21.8
Montana	3,240,973	3,147,678	3,143,638	3,324,195	+2.6	+5.6	+5.7
New Mexico	3,708,806	2,915,173	2,935,539	2,711,851	−26.9	−7.0	−7.6
North Dakota	495,320	1,385,400	1,527,939	1,649,930	+233.0	+19.1	+8.0
Ohio	36,200,527	40,546,443	15,799,697	15,641,225	−56.8	−61.4	−1.0
Oklahoma	4,165,770	2,885,038	3,818,054	3,501,325	−16.0	+21.4	−8.3
Pennsylvania	173,781,217	171,879,913	132,964,639	131,202,163	−24.5	−23.7	−1.3
South Dakota	10,540	10,379	12,507	13,929	+32.2	+34.2	+11.4
Tennessee	6,860,184	6,040,268	5,783,367	5,610,959	−18.2	−7.1	−3.0
Texas	2,429,144	1,187,329	1,326,385	1,182,034	−51.3	−.4	−10.9
Utah	3,254,828	4,720,217	4,781,480	4,842,544	+48.8	+2.6	+1.3
Virginia	8,828,068	11,761,643	12,916,042	11,900,933	+34.8	+1.2	−7.9
Washington	3,877,891	2,926,392	2,635,062	2,519,901	−32.0	−13.9	−4.4
West Virginia	71,254,136	107,899,941	145,122,447	132,952,159	+86.6	+23.2	−8.4
Wyoming	7,393,066	7,575,031	6,753,656	6,571,683	−11.1	−13.2	−2.7
Other States	75,151	175,911	190,101	214,448	+185.4	+21.9	+12.8
	478,435,297	564,564,662	517,763,352	500,744,970	+4.7	−11.3	−3.3

TABLE 11.—*Coal produced in 1928, by States, and highest recorded production*

State	1928, net tons	Maximum production	
		Year	Net tons
Alabama	17,621,362	1926	21,000,962
Alaska	126,100	1928	126,100
Arkansas	1,660,973	1907	2,670,438
California, Idaho, and Oregon	[1] 27,488	1880	280,155
Colorado	9,847,707	1917	12,483,336
Georgia	58,390	1903	416,951
Illinois	55,948,199	1918	89,291,105
Indiana	16,378,580	1918	30,678,634
Iowa	3,683,635	1917	8,965,830
Kansas	2,809,724	1918	7,561,947
Kentucky	61,860,379	1927	69,123,998
Maryland	2,686,979	1907	5,532,628
Michigan	617,342	1907	2,035,858
Missouri	3,732,421	1917	5,670,549
Montana	3,324,195	1918	4,532,505
New Mexico	2,711,851	1918	4,023,239
North Carolina	60,860	1922	78,570
North Dakota	1,649,930	1928	1,649,930
Ohio	15,641,225	1920	45,878,191
Oklahoma	3,501,325	1920	4,849,288
Pennsylvania, bituminous	131,202,163	1918	178,550,741
South Dakota	13,929	1925	14,447
Tennessee	5,610,959	1910	7,121,380
Texas	1,182,034	1913	2,429,144
Utah	4,842,544	1920	6,005,199
Virginia	11,900,933	1926	14,133,386
Washington	2,519,901	1918	4,082,212
West Virginia	132,952,159	1927	145,122,447
Wyoming	6,571,683	1920	9,630,271
Pennsylvania, anthracite	75,348,069	1917	99,611,811

[1] Includes also Arizona.

TOTAL PRODUCTION SINCE BEGINNING OF MINING

TABLE 12.—*Coal produced, by States, 1916–1928, with cumulative total production from the earliest record to the end of 1928, in thousands of net tons*

State	1916	1917	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	Total production from earliest record to end of 1928
Alabama	18,086	20,068	19,185	15,537	16,294	12,569	18,325	20,458	19,130	20,004	21,001	19,766	17,621	523,520
Arkansas	1,995	2,143	2,227	1,429	2,103	1,228	1,110	1,297	1,452	1,220	1,459	1,549	1,661	60,922
Colorado	10,484	12,483	12,408	10,323	12,278	9,123	10,020	10,346	10,444	10,311	10,637	9,724	9,848	330,587
Georgia	174	119	67	53	50	34	61	76	75	66	60	77	58	10,695
Illinois	66,195	86,199	89,291	60,863	88,725	69,603	58,468	79,310	68,323	66,909	69,367	46,848	55,948	1,987,985
Indiana	20,094	26,539	30,679	20,912	29,351	20,319	19,133	26,229	21,480	21,225	23,186	17,936	16,379	578,741
Iowa	7,261	8,966	8,192	5,625	7,814	4,531	4,335	5,711	5,468	4,715	4,626	2,950	3,684	275,545
Kansas	6,881	7,185	7,562	5,225	5,926	3,467	2,955	4,443	4,248	4,524	4,416	3,444	2,810	206,469
Kentucky	25,394	27,808	31,613	30,036	35,691	31,588	42,134	44,777	45,147	55,069	62,924	69,124	61,860	813,039
Maryland	4,460	4,746	4,497	3,022	4,065	1,828	1,223	2,286	2,134	2,695	3,078	2,815	2,687	223,503
Michigan	1,180	1,375	1,465	996	1,490	1,142	929	1,172	831	808	687	757	617	38,800
Missouri	4,742	5,670	5,668	3,980	5,370	3,551	2,925	3,403	2,481	2,694	3,008	3,064	3,733	178,206
Montana	3,633	4,227	4,532	3,236	4,414	2,734	2,572	3,148	2,905	3,044	2,798	3,144	3,324	90,705
New Mexico	3,793	4,001	4,023	3,139	3,683	2,453	3,147	2,915	2,786	2,557	2,818	2,935	2,712	90,176
North Carolina	--------	--------	1	7	12	23	78	36	57	65	58	53	61	930
North Dakota	635	791	720	841	949	865	1,327	1,385	1,200	1,325	1,370	1,528	1,650	21,044
Ohio	34,728	40,749	45,813	35,877	45,878	31,943	26,954	40,547	30,473	28,034	27,873	15,800	15,641	1,144,265
Oklahoma	3,608	4,387	4,813	3,802	4,849	3,363	2,803	2,885	2,330	2,326	2,843	3,818	3,501	112,484
Oregon	43	28	13	18	21	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	[2] 2,380
Pennsylvania, bituminous	170,295	172,448	178,551	150,758	170,608	116,014	113,148	171,880	130,634	136,928	153.042	132,965	131,202	4,966,356
Tennessee	6,137	6,194	6,831	5,213	6,662	4,460	4,877	6,040	4,557	5,454	5,789	5,783	5,611	209,033
Texas	1,988	2,356	2,261	1,681	1,615	973	1,106	1,187	1,147	1,008	1,091	1,326	1,182	49,983
Utah	3,567	4,125	5,137	4,631	6,005	4,079	4,992	4,720	4,488	4,690	4,374	4,781	4,843	100,898
Virginia	9,708	10,087	10,290	9,327	11,379	7,492	10,491	11,762	10,693	12,800	14,133	12,916	11,901	255,348
Washington	3,039	4,010	4,082	2,990	3,757	2,429	2,581	2,927	2.654	2,538	2,587	2,635	2,520	108,701
West Virginia	86,460	86,442	89,936	79,037	89,971	72,787	80,488	107,900	101,663	122,381	143,509	145,122	132,952	2,275,028
Wyoming	7,911	8,576	9,439	7,220	9,630	7,201	5,972	7,575	6,757	6,553	6,512	6,754	6,572	228,441
Other States	29	68	90	82	77	123	114	150	129	110	121	149	167	45.600
Total bituminous	502,520	551,790	579,386	465,860	568,667	415,922	422,268	564,565	483,686	520,053	573,367	517,763	500,745	14,929,384
Pennsylvania anthracite	87,578	99,612	98,826	88,092	89,598	90,473	54,683	93,339	87,927	61,817	84,437	80,096	75,348	3,718,340
Grand total	590,098	651,402	678,212	553,952	658,265	506,395	476,951	657,904	571,613	581,870	657,804	597,859	576,093	18,647,724

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[1] Included under "Other States."

[2] Total through 1920.

PRODUCTION, BY FIELDS

Many requests are received for information on production by trade fields as distinct from States and counties. In Table 13 the operators' reports to the Bureau of Mines have been retabulated according to the 92 fields into which the United States Coal Commission grouped the bituminous-coal mines. Corresponding figures for 1920 and 1921 will be found in Coal in 1923, pages 534 and 535; for 1922 and 1924, in Coal in 1924, pages 471 and 472; for 1925, in Coal in 1925, pages 417 and 418; for 1926, in Coal in 1926, pages 460 and 461; and for 1927, in Coal in 1927, pages 354 and 355. Data on production by fields in 1917 and 1918 are given in Coal in 1918, Part A, page 705. The grouping of the fields used therein is that adopted for administrative purposes by the United States Fuel Administration and is explained on page 114 of Part I of the Report of the Distribution Division of the Fuel Administration. This grouping differs from that of the United States Coal Commission.

The commission's grouping of the fields was made under the direction of C. E. Lesher and R. A. Walter, primarily with a view to its studies of cost of production. The fields are accurately delimited by metes and bounds on pages 2034 to 2052 of the commission's report. Because all the fields adopted did not coincide with generally accepted trade districts they were designated by number rather than by name. For the convenience of the reader of Table 13, however, the trade name most nearly corresponding to the boundaries established by the commission is also listed.

TABLE 13.—*Bituminous coal produced and number of mines active in the several fields adopted by the United States Coal Commission, 1923 and 1928*

[The definitions of these fields are given in detail on pp. 2034–2052, Pt. IV, of the Report of the U. S. Coal Commission]

Coal Commission field No.	State	General name of field	1923		1928	
			Number of mines	Production (net tons)	Number of mines	Production (net tons)
1	Pennsylvania	Pittsburgh	452	42,209,000	240	27,505,000
2	do	Connellsville	312	37,882,000	149	35,546,000
3	do	Westmoreland-Ligonier	171	14,563,000	86	11,052,000
4a, b	do	Freeport (thick and thin)	123	12,338,000	89	7,559,000
5	do	Butler-Mercer	110	2,587,000	69	2,312,000
6	do	Blossburg	20	496,000	12	151,000
7	do	Broad Top	63	1,430,000	39	970,000
8	do	Somerset	232	5,772,000	125	6,651,000
9a	do	Central Pennsylvania, western.	1,385	54,364,000	80	2,932,000
9b	do	Central Pennsylvania, middle.			140	8,984,000
9c	do	Central Pennsylvania, eastern.			528	27,540,000
10	Maryland-West Virginia	Maryland-Potomac	159	3,890,000	114	4,229,000
11	West Virginia	Fairmont	309	22,883,000	164	23,918,000
12	Ohio-West Virginia	Panhandle-Pittsburgh No. 8	233	25,529,000	175	15,530,000
13	do	Pomeroy	41	1,309,000	28	872,000
14	West Virginia	Putnam County	10	345,000	3	429,000
15	Kentucky-West Virginia	Kenova	38	2,103,000	23	3,205,000
16	do	Thacker	89	6,149,000	56	7,642,000
17	West Virginia	Tug River	87	4,555,000	55	7,691,000
18	Virginia-West Virginia	Pocahontas	107	16,481,000	82	18,959,000
19	West Virginia	Winding Gulf	78	7,228,000	60	11,089,000
20	do	New River	145	8,810,000	110	13,079,000
21	do	Kanawha	285	12,741,000	134	17,040,000
22	do	Coal River	29	1,397,000	13	2,250,000
23	do	Logan	155	12,831,000	87	17,685,000
24a	do	Coal and Coke	39	1,158,000	10	981,000
24b	do	Preston County	58	1,937,000	35	1,638,000
24c	do	Taylor County, Junior, Philippi, and Gauley.	176	6,140,000	92	5,074,000

TABLE 13.—*Bituminous coal produced and number of mines active in the several fields adopted by the United States Coal Commission, 1923 and 1928*—Continued.

Coal Commission field No.	State	General name of field	1923		1928	
			Number of mines	Production (net tons)	Number of mines	Production (net tons)
25	Virginia	Southwestern Virginia	123	8,148,000	58	8,097,000
26	do	Clinch Valley	34	2,464,000	18	2,272,000
27	do	Upper New River	[1] 8	[1] 217,000	7	172,000
28	do	Richmond Basin	(1)	(1)	-------	-----------
29	Ohio	Massillon-Palmyra-Lisbon	90	2,815,000	97	1,359,000
30	do	Coshocton-Goshen	155	3,174,000	152	1,807,000
31	do	Cambridge	55	4,780,000	42	891,000
32	do	Crooksville	60	1,015,000	56	375,000
33	do	Hocking	241	7,517,000	85	1,684,000
34	do	Jackson and Ironton	89	610,000	49	385,000
36	Kentucky	Northeast Kentucky	225	9,602,000	125	12,969,000
37	do	Hazard	128	6,660,000	81	7,832,000
38	do	Harlan	75	8,752,000	61	14,564,000
39	Kentucky-Tennessee	Southern Appalachian	221	6,765,000	104	7,036,000
40	do	Jellico	55	1,003,000	23	777,000
41	Kentucky	Western Kentucky	172	10,890,000	147	16,277,000
42	Tennessee	Rockwood-Soddy	89	2,563,000	41	2,067,000
43	do	Fentress	13	541,000	6	778,000
44	Alabama	Big Seam Group	45	5,954,000	43	5,628,000
45	Alabama-Georgia	Cahaba Group	109	5,846,000	92	5,096,000
46	Alabama	Pratt Group	137	8,696,000	78	6,955,000
47	Indiana	Indiana	272	25,793,000	157	16,235,000
48	do	Brazil Block	29	345,000	12	143,000
49	Illinois	Northern Illinois	60	2,334,000	50	1,265,000
50	do	Fulton-Peoria	119	4,190,000	160	4,020,000
51	do	Danville	32	4,178,000	41	3,390,000
52	do	Central Illinois	108	25,205,000	80	15,416,000
53	do	Belleville	106	10,193,000	88	6,263,000
54	do	Murphysboro	10	557,000	11	518,000
55	do	Southern Illinois	140	32,595,000	117	25,077,000
56	Michigan	Michigan	13	1,172,000	7	617,000
57	Arkansas	Sebastian	54	899,000	36	1,139,000
58	do	Excelsior-Logan	22	112,000	26	223,000
59	do	Arkansas "anthracite"	18	222,000	17	299,000
60	Colorado	Colorado (domestic)	145	4,430,000	141	4,111,000
61	do	Trinidad	44	3,182,000	35	2,911,000
62	do	Northern Colorado	47	2,715,000	39	2,826,000
63	Iowa	Marion-Monroe-Polk	89	4,485,000	145	2,795,000
64	do	Appanoose	62	1,217,000	77	889,000
65	Kansas	Pittsburg	192	4,135,000	194	2,616,000
66	do	Lightning Creek				
67	do	Osage	27	115,000	37	111,000
68	do	Leavenworth [2]	4	137,000	3	120,000
69	Missouri	Southern Missouri [3]	79	2,114,000	122	2,577,000
70	do	Lafayette	69	1,141,000	93	1,118,000
71	do	Grundy	(3)	(3)	(2)	(2)
72	do	Platte	(2)	(2)	(2)	(2)
73	Montana	Montana	48	3,144,000	63	3,324,000
74	New Mexico	Gallup	13	939,000	13	969,000
75	do	Anthracite	11	248,000	10	246,000
76	do	Raton	15	1,678,000	12	1,465,000
76a	do	Monero	3	33,000	4	31,000
77	North Dakota	Southern North Dakota	72	910,000	102	1,008,000
78	do	Northern North Dakota	50	447,000	48	642,000
79	Oklahoma	McAlester Vein	25	640,000	26	499,000
80	do	Oklahoma, eastern	90	2,200,000	111	3,002,000
81	Texas	Texas (bituminous)	10	175,000	4	118,000
82	do	Texas (lignite)	34	1,012,000	22	1,064,000
83	Utah	Utah	37	4,720,000	38	4,843,000
84	Washington	Kittitas County	12	1,358,000	7	1,077,000
85	do	Pierce-King (bituminous)	16	605,000	25	1,031,000
86	do	Lewis	28	963,000	20	412,000
87	Wyoming	Wyoming	62	7,559,000	58	6,572,000
88	South Dakota	South Dakota	15	10,000	17	14,000
89	Oregon	Oregon	(4)	(4)	(4)	(4)
90	California [4]	California [4]	5	20,000	5	24,000
91	Nevada	Nevada	-------	-----------	-------	-----------
92	North Carolina	North Carolina	2	36,000	2	61,000
	Unclassified		12	120,000	12	130,000
			9,331	563,422,000	6,450	560,745,000

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[1] Upper New River field includes Richmond Basin field (No. 28).

[2] Leavenworth field, Kansas, includes Platte field, Missouri (No. 72), in 1923 and 1928 and Grundy field, Missouri (No. 71), in 1928.

[3] Southern Missouri field includes Grundy field (No. 71) in 1923.

[4] California includes Idaho and Oregon.

PRODUCTION, BY GEOLOGIC PROVINCES

Table 14.—*Production of bituminous coal and lignite, by geologic provinces, in 1913 and 1916–1928, in net tons*

[The production statistics compiled by the Bureau of Mines are usually arranged by States and counties in alphabetical order. In the following table they are regrouped to accord roughly with broad geologic provinces. This grouping will be found useful in studying the degree of exhaustion of the resources and the competitive position of the several fields because the natural conditions that largely control the cost of mining are closely related to the geology]

Province	1913	1916	1917	1918	1919	1920	1921
Northern and Middle Appalachians (Pennsylvania, Ohio, Maryland, West Virginia, Eastern Kentucky, Virginia, and Tennessee)	312, 863, 044	329, 396, 180	338, 259, 270	356, 731, 603	304, 636, 935	353, 217, 522	257, 496, 572
Southern Appalachians (Alabama)	17, 678, 522	18, 086, 197	20, 068, 074	19, 184, 962	15, 536, 721	16, 294, 099	12, 568, 899
Northern Interior (Michigan)	1, 231, 786	1, 180, 360	1, 374, 805	1, 464, 818	996, 545	1, 489, 765	1, 141, 715
Eastern Interior (Illinois, Indiana, and Western Kentucky)	87, 241, 942	94, 075, 420	122, 953, 196	130, 768, 429	90, 407, 132	129, 111, 736	98, 538, 128
Northern Western Interior (Iowa, Missouri, and Kansas)	19, 046, 271	18, 884, 401	21, 821, 354	21, 421, 872	14, 829, 214	19, 109, 889	11, 549, 654
Middle Western Interior (Arkansas and Oklahoma)	6, 399, 877	5, 602, 926	6, 530, 423	7, 040, 816	5, 231, 133	6, 952, 884	4, 590, 400
Southwestern Interior (Texas, bituminous)	1, 247, 988	1, 025, 093	1, 259, 276	1, 074, 183	734, 087	545, 227	210, 638
Gulf Coast (Texas, lignite)	1, 181, 156	962, 410	1, 096, 539	1, 186, 952	946, 569	1, 069, 788	762, 201
Northern Great Plains (North Dakota, lignite)	495, 320	634, 912	790, 548	719, 733	840, 959	948, 625	864, 903
Rocky Mountains (Montana, Wyoming, Colorado, Utah, and New Mexico)	26, 830, 183	29, 387, 850	33, 411, 401	35, 538, 828	28, 549, 606	36, 011, 001	25, 589, 650
Pacific Coast (Washington)	3, 877, 891	3, 038, 588	4, 009, 902	4, 082, 212	2, 990, 447	3, 757, 093	2, 428, 722
Grand total[1]	478, 435, 297	502, 519, 682	551, 790, 563	579, 385, 820	465, 860, 058	568, 666, 683	415, 921, 950

Province	1922	1923	1924	1925	1926	1927	1928
Northern and Middle Appalachians (Pennsylvania, Ohio, Maryland, West Virginia, Eastern Kentucky, Virginia, and Tennessee)	265, 580, 998	374, 301, 172	316, 280, 532	351, 173, 229	394, 884, 385	363, 320, 442	345, 577, 581
Southern Appalachians (Alabama)	18, 324, 740	20, 457, 649	19, 130, 184	20, 004, 395	21, 000, 962	19, 765, 866	17, 621, 362
Northern Interior (Michigan)	929, 390	1, 172, 075	831, 020	808, 233	686, 707	756, 763	617, 342
Eastern Interior (Illinois, Indiana, and Western Kentucky)	91, 334, 748	116, 429, 453	98, 823, 565	100, 320, 882	108, 016, 952	85, 988, 572	88, 603, 995
Northern Western Interior (Iowa, Missouri, and Kansas)	10, 215, 081	13, 557, 035	12, 197, 063	11, 933, 309	12, 050, 462	9, 457, 727	10, 225, 780
Middle Western Interior (Arkansas and Oklahoma)	3, 912, 557	4, 181, 930	3, 781, 118	3, 545, 879	4, 301, 690	5, 366, 888	5, 162, 298
Southwestern Interior (Texas, bituminous)	265, 179	175, 332	163, 196	182, 680	170, 494	156, 899	117, 849
Gulf Coast (Texas, lignite)	840, 828	1, 011, 997	983, 815	825, 695	920, 664	1, 169, 486	1, 064, 185
Northern Great Plains (North Dakota, lignite)	1, 327, 564	1, 385, 400	1, 200, 527	1, 324, 620	1, 370, 244	1, 527, 939	1, 649, 930
Rocky Mountains (Montana, Wyoming, Colorado, Utah, and New Mexico)	26, 702, 723	28, 704, 317	27, 381, 151	27, 154. 662	27, 138, 989	27, 338, 388	27, 297, 980
Pacific Coast (Washington)	2, 581, 165	2, 926, 392	2, 653, 667	2, 537, 890	2, 586, 568	2, 635, 062	2, 519, 901
Grand total[1]	422, 268, 099	564, 564, 662	483, 686, 538	520, 052, 741	573, 366, 985	517, 763, 352	500, 744, 970

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[1] Totals include Alaska, Arizona, California, Georgia, Idaho, Nebraska, Nevada, North Carolina, Oregon, and South Dakota, which are not covered by the group totals above

PRODUCTION, BY WEEKS AND MONTHS

The following tables summarize the statistics of the weekly and monthly production of bituminous coal that are first published in the Bureau of Mines weekly coal reports. The figures given are estimates based upon daily and weekly reports of cars of coal and beehive coke loaded by the principal railroads and of shipments over the Monongahela, Allegheny, Ohio, and Kanawha Rivers. The estimates are afterwards revised to agree with the results of the annual statistical reports from the producers of coal; therefore, the figures here given differ slightly from the estimates originally issued in the weekly reports.

If production in February, with 28 days, is compared to that in January, with 31 days, a downward drop is often seen, which may give a mistaken impression as to the real trend. A better indication is given by the average production per working day, and it is the practice of the Bureau of Mines in tables of monthly or weekly coal production to show the average per working day as well as the total for the period. Christmas and Fourth of July are universally observed at the mines. A number of other holidays are observed in some districts but not in others. New Year's Day is very generally observed, but in 1928 enough mines continued at work on that day so that over the country, as a whole, the day counted for three-tenths of a normal working day. February 22, on the other hand, is little observed as a holiday and in 1928 counted for nine-tenths of a working day. Table 16 shows the allowances made in the bureau's records for holidays at the bituminous mines in the last eight years. These allowances are made in the light of the daily reports of cars of coal loaded, collected by the American Railway Association. Loadings on the holiday are compared with those on the corresponding day of the weeks immediately preceding and following, and the degree of holiday observance is computed accordingly. After allowing for the observance of holidays the weighted average potential working year for the country, as a whole, was 307 days in 1928.

As may be seen from Table 15, the weekly rate of output was well above 10,000,000 tons for 15 consecutive weeks during the latter part of 1928. Monthly production, which ranged from 42,022,000 to 44,925,000 tons in the first quarter, declined to lower levels in the 6 months from April to September. (See fig. 7.) The highest monthly output during the year—51,176,000 tons in October—was considerably below the monthly record of 59,911,000 tons established in March, 1927. (See Table 17.) Indeed, production in four months of 1926 and in three months of 1927 exceeded the October (1928) figure.

An indicator of the month-to-month activity in the various mining districts is found in the detailed statistics showing monthly output in the various States. (See Table 18.) In 1928 production in some areas, such as West Virginia and eastern Kentucky, continued throughout the summer at approximately winter levels. In other States, such as Illinois and Indiana, there was a notable recession in output, due largely to the renewal of the labor suspension in a number of union districts on April 1.

TABLE 15.—*Estimated weekly production of bituminous coal in 1928*

Week ended—	Production (net tons)	Number of working days	Average production per working day (net tons)	Week ended—	Production (net tons)	Number of working days	Average production per working day (net tons)
Jan. 7	10,008,000	5.3	1,888,000	July 21	8,782,000	6	1,464,000
Jan. 14	11,041,000	6	1,840,000	July 28	9,109,000	6	1,518,000
Jan. 21	9,882,000	6	1,647,000	Aug. 4	8,899,000	6	1,483,000
Jan. 28	10,285,000	6	1,714,000	Aug. 11	9,148,000	6	1,525,000
Feb. 4	10,269,000	6	1,712,000	Aug. 18	9,104,000	6	1,517,000
Feb. 11	9,907,000	6	1,651,000	Aug. 25	9,426,000	6	1,571,000
Feb. 18	9,526,000	6	1,588,000	Sept. 1	9,589,000	6	1,598,000
Feb. 25	10,342,000	5.9	1,753,000	Sept. 8	9,080,000	5.4	1,681,000
Mar. 3	10,200,000	6	1,700,000	Sept. 15	10,362,000	6	1,727,000
Mar. 10	10,560,000	6	1,760,000	Sept. 22	10,183,000	6	1,697,000
Mar. 17	10,104,000	6	1,684,000	Sept. 29	11,235,000	6	1,873,000
Mar. 24	10,031,000	6	1,672,000	Oct. 6	11,218,000	6	1,870,000
Mar. 31	9,460,000	6	1,577,000	Oct. 13	11,457,000	6	1,910,000
Apr. 7	7,274,000	5.7	1,276,000	Oct. 20	11,008,000	6	1,835,000
Apr. 14	7,535,000	6	1,256,000	Oct. 27	11,430,000	6	1,905,000
Apr. 21	8,045,000	6	1,341,000	Nov. 3	11,321,000	6	1,887,000
Apr. 28	8,325,000	6	1,388,000	Nov. 10	10,717,000	5.4	1,985,000
May 5	8,307,000	6	1,384,000	Nov. 17	11,101,000	5.7	1,948,000
May 12	8,528,000	6	1,421,000	Nov. 24	11,160,000	6	1,860,000
May 19	8,315,000	6	1,386,000	Dec. 1	10,067,000	5.2	1,936,000
May 26	8,510,000	6	1,418,000	Dec. 8	11,393,000	6	1,899,000
June 2	7,502,000	5.4	1,389,000	Dec. 15	11,214,000	6	1,869,000
June 9	8,518,000	6	1,425,000	Dec. 22	11,235,000	6	1,873,000
June 16	8,477,000	6	1,413,000	Dec. 29	7,002,000	5	1,400,000
June 23	8,527,000	6	1,421,000	Jan. 5	[1] 1,725,000	[1] 1	[2] 1,830,000
June 30	8,581,000	6	1,430,000				
July 7	6,941,000	5	1,388,000		500,745,000	307.0	1,631,000
July 14	8,750,000	6	1,458,000				

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[1] Figures represent the output and the number of working days in that part of the week included in the calendar year shown. Total production for this week was 9,881,000 tons.

[2] Average daily production for the entire week and not for the working days that fell in the calendar year shown.

TABLE 16.—*Holidays commonly recognized in the bituminous coal fields and the average fraction of a working day for the country, as a whole, that each holiday represented, 1921–1928*

	Average fraction of full working day							
	1921	1922	1923	1924	1925	1926	1927	1928
January: New Year's Day	0.2	0.2	0.3	0.2	0.3	0.3	0.3	0.3
February: Washington's Birthday	(1)	(1)	.9	.8	.9	.9	.9	.9
April: Eight-Hour Day (Apr. 1)	.3	.3	.4	.5	.6	.7	.7	.7
May: Memorial Day	.2	.8	.3	.4	.4	.4	.4	.4
July: Independence Day	-------	-------	-------	-------	-------	-------	-------	-------
September: Labor Day	.3	.3	.3	.3	.4	.4	.4	.4
November:								
General election	-------	-------	-------	.4	-------	.7	-------	.4
Armistice Day	.5	.5	.4	.6	.7	.7	.7	.7
Thanksgiving Day	.3	.2	.1	.2	.3	.5	.1	.2
December: Christmas Day	-------	-------	-------	-------	-------	-------	-------	-------

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(1) Data for weighting not available.

TABLE 17.—*Estimated monthly production of bituminous coal and average production per working day, 1925–1928,*[1] *in thousands of net tons*

Month	1925		1926		1927		1928	
	Total	Daily average	Total	Daily average	Total	Daily average	Total	Daily average
January	51,640	1,963	53,205	2,103	56,660	2,240	44,925	1,776
February	38,770	1,622	46,180	1,932	52,697	2,205	42,022	1,688
March	37,416	1,439	45,744	1,694	59,911	2,219	44,668	1,654
April	33,514	1,309	39,738	1,546	34,538	1,344	32,710	1,324
May	35,276	1,389	38,727	1,525	35,256	1,388	37,218	1,410
June	36,960	1,422	41,635	1,601	36,483	1,403	36,546	1,406
July	39,362	1,514	43,102	1,658	33,505	1,340	36,864	1,475
August	44,633	1,717	45,957	1,767	41,541	1,539	41,774	1,547
September	46,556	1,833	48,559	1,912	41,763	1,644	41,971	1,720
October	52,907	1,960	54,127	2,082	43,827	1,686	51,176	1,895
November	50,497	2,131	59,213	2,378	40,468	1,632	46,788	1,925
December	52,522	2,020	57,180	2,199	41,114	1,581	44,083	1,763
	520,053	1,692	573,367	1,864	517,763	1,684	500,745	1,631

[1] Monthly statistics from 1905 to 1924 will be found in Coal in 1922, pp. 464–465, and in Coal in 1924, p. 476.

TABLE 18.—*Estimated monthly production of coal, by States, in 1928, in thousands of net tons*

State	January	February	March	April	May	June	July	August	September	October	November	December	Total
Alabama	1,630	1,479	1,531	1,455	1,517	1,355	1,318	1,388	1,369	1,568	1,507	1,504	17,621
Arkansas	142	120	102	89	102	96	129	166	198	208	152	157	1,661
Colorado	997	846	746	706	614	555	632	760	892	977	1,000	1,123	9,848
Illinois	6,139	5,974	7,522	1,316	2,797	3,108	3,233	3,844	4,227	6,103	5,581	6,104	55,948
Indiana	1,655	1,711	2,160	806	921	1,008	1,026	1,207	1,277	1,424	1,456	1,728	16,379
Iowa	406	367	402	216	225	207	215	261	289	350	361	385	3,684
Kansas	327	352	345	133	133	119	109	151	201	316	287	337	2,810
Kentucky:													
Eastern	3,800	3,530	3,536	3,198	3,904	3,748	3,743	4,280	4,009	4,584	3,941	3,310	45,583
Western	1,604	1,515	1,767	1,381	1,000	961	1,010	1,192	1,340	1,636	1,392	1,479	16,277
Maryland	261	232	226	180	189	193	193	222	222	263	251	255	2,687
Michigan	76	71	71	55	53	50	49	56	49	13	11	63	617
Missouri	443	294	302	231	220	239	260	302	335	395	335	376	3,732
Montana	346	273	283	201	189	166	201	276	341	414	346	288	3,324
New Mexico	313	236	246	219	215	191	191	227	210	215	228	221	2,712
North Dakota	198	175	117	68	33	39	31	60	122	262	301	244	1,650
Ohio	814	850	906	844	1,011	1,137	1,284	1,527	1,552	2,050	1,896	1,770	15,641
Oklahoma	356	275	211	163	227	196	235	284	344	409	393	408	3,501
Pennsylvania	11,318	10,755	11,098	9,803	10,302	9,936	9,880	10,842	10,721	13,194	12,135	11,218	131,202
Tennessee	487	478	492	441	444	409	420	454	445	563	504	474	5,611
Texas	118	100	95	74	85	83	99	108	119	116	99	86	1,182
Utah	564	373	337	297	237	256	279	369	475	564	488	604	4,843
Virginia	994	953	949	840	902	902	951	1,004	985	1,182	1,178	1,061	11,901
Washington	237	201	209	182	190	173	196	210	231	226	228	237	2,520
West Virginia	10,950	10,297	10,449	9,360	11,308	11,021	10,765	12,041	11,366	13,396	12,004	9,995	132,952
Wyoming	719	539	542	431	377	375	391	520	628	724	691	635	6,572
Other States	31	26	24	21	23	23	24	23	24	24	23	21	287
Total bituminous	44,925	42,022	44,668	32,710	37,218	36,546	36,864	41,774	41,971	51,176	46,788	44,083	500,745
Pennsylvania anthracite	5,587	5,481	5,398	6,784	7,977	5,205	4,394	6,759	5,927	8,400	7,322	6,114	75,348
Grand total	50,512	47,503	50,066	39,494	45,195	41,751	41,258	48,533	47,898	59,576	54,110	50,197	576,093

TABLE 19.—*Estimated daily output of coal, by States, in each month of 1928, in thousands of net tons*

State	January	February	March	April	May	June	July	August	September	October	November	December	Total
Alabama	64.4	59.4	56.7	58.9	57.5	52.1	52.7	51.4	56.1	58.1	62.0	60.2	57.4
Arkansas	5.6	4.8	3.8	3.6	3.9	3.7	5.2	6.1	8.1	7.7	6.2	6.3	5.4
Colorado	39.4	34.0	27.6	28.6	23.2	21.4	25.3	28.1	36.6	36.2	41.1	44.9	32.1
Illinois	242.6	239.9	278.6	53.3	105.9	119.5	129.3	142.4	173.2	226.0	229.7	244.1	182.2
Indiana	65.4	68.7	80.0	32.6	34.9	38.8	41.0	44.7	52.3	52.7	59.9	69.1	53.3
Iowa	16.0	14.7	14.9	8.7	8.5	8.0	8.6	9.6	11.8	13.0	14.9	15.4	12.0
Kansas	12.9	14.1	12.8	5.4	5.0	4.6	4.4	5.6	8.2	11.7	11.8	13.5	9.2
Kentucky:													
Eastern	150.2	141.8	131.0	129.5	147.9	144.2	149.7	158.5	164.3	169.8	162.2	132.4	148.5
Western	63.4	60.9	65.5	55.9	37.9	37.0	40.4	44.1	54.9	60.6	57.3	59.2	53.0
Maryland	10.3	9.3	8.4	7.3	7.2	7.4	7.7	8.2	9.1	9.7	10.3	10.2	8.8
Michigan	3.0	2.9	2.6	2.2	2.0	1.9	2.0	2.1	2.0	.5	.5	2.5	2.0
Missouri	17.5	11.8	11.2	9.4	8.3	9.2	10.4	11.2	13.7	14.6	13.8	15.0	12.2
Montana	13.7	11.0	10.5	8.1	7.2	6.4	8.1	10.2	14.0	15.3	14.2	11.5	10.8
New Mexico	12.4	9.5	9.1	8.9	8.1	7.3	7.6	8.4	8.6	8.0	9.4	8.8	8.8
North Dakota	7.8	7.0	4.3	2.7	1.2	1.5	1.2	2.2	5.0	9.7	12.4	9.8	5.4
Ohio	32.2	34.1	33.6	34.2	38.3	43.7	51.4	56.6	63.6	75.9	78.0	70.8	50.9
Oklahoma	14.1	11.1	7.8	6.6	8.6	7.5	9.4	10.5	14.1	15.1	16.2	16.3	11.4
Pennsylvania, bituminous	447.4	431.9	411.0	396.9	390.2	382.1	395.2	401.6	439.4	488.7	499.4	448.7	427.4
Tennessee	19.3	19.2	18.2	17.9	16.8	15.7	16.8	16.8	18.2	20.8	20.7	19.0	18.3
Texas	4.7	4.0	3.5	3.0	3.2	3.2	4.0	4.0	4.9	4.3	4.1	3.5	3.8
Utah	22.3	15.0	12.5	12.0	9.0	9.8	11.2	13.7	19.5	20.9	20.1	24.2	15.8
Virginia	39.3	38.3	35.1	34.0	34.2	34.7	38.0	37.2	40.4	43.8	48.5	42.4	38.8
Washington	9.4	8.1	7.7	7.4	7.2	6.7	7.8	7.8	9.5	8.4	9.4	9.5	8.2
West Virginia	432.8	413.5	387.0	378.9	428.3	423.9	430.6	446.0	465.8	496.2	494.0	399.8	433.1
Wyoming	28.4	21.7	20.1	17.4	14.3	14.4	15.6	19.3	25.8	26.8	28.4	25.4	21.4
Other States	1.2	1.0	.9	.8	.9	.9	1.0	.9	1.0	.9	.9	.8	.9
Total bituminous	1,775.7	1,687.7	1,654.4	1,324.2	1,409.7	1,405.6	1,474.6	1,547.2	1,720.1	1,895.4	1,925.4	1,763.3	1,631.1
Pennsylvania anthracite	223.5	223.7	199.9	282.7	306.8	200.2	175.8	250.3	247.0	323.1	305.1	244.6	248.3
Grand total	1,999.2	1,911.4	1,854.3	1,606.9	1,716.5	1,605.8	1,650.4	1,797.5	1,967.1	2,218.5	2,230.5	2,007.9	1,879.4

MONTHLY PRODUCTION OF BITUMINOUS COAL LESS COAL EQUIVALENT OF COKE MADE

If a statistical series representing bituminous-coal output is desired which can be used without double counting in conjunction with a series on monthly coke production, it is necessary to deduct the coal equivalent of all coke—beehive and by-product—from the total production of coal.[11] This has been done in Table 20 for the period 1912 to 1928. From historical data it has been possible to show the monthly record of bituminous-coal production minus the coal equivalent of coke made in the same month.

Examination of the continuous monthly series over a long period may be interesting to students of the business cycle. Comparable current figures can be determined easily from the current statistics on coal and coke now issued by the Bureau of Mines.

TABLE 20.—*Monthly production of bituminous coal less coal equivalent of coke made in the same month, 1912–1928, in thousands of net tons* [a]

Month	1912	1913	1914	1915	1916	1917	1918	1919	1920
January	33,080	35,985	35,705	33,768	39,971	40,873	36,365	35,051	43,260
February	34,348	31,210	31,005	25,712	38,698	34,881	38,118	26,284	35,048
March	38,641	31,491	39,950	27,584	36,604	40,410	41,067	28,355	40,991
April	20,189	28,298	18,634	25,703	27,072	34,816	39,126	27,810	33,057
May	27,919	31,139	24,115	26,447	31,880	39,948	43,143	33,722	33,800
June	28,953	31,610	27,214	29,038	31,092	39,844	43,922	33,116	39,907
July	29,434	32,985	29,926	30,306	31,672	39,309	47,259	37,930	39,571
August	33,713	35,679	33,421	32,460	35,782	40,497	47,562	37,754	43,309
September	32,109	35,638	34,884	35,136	35,159	38,110	43,681	42,414	43,600
October	36,120	40,237	33,790	37,581	37,631	41,291	44,520	52,372	46,406
November	35,347	38,012	30,116	38,083	38,053	40,796	36,603	13,662	46,222
December	34,674	36,911	32,320	38,975	37,297	37,264	32,992	31,802	47,305
	384,527	409,195	371,080	380,793	420,911	468,039	494,358	400,272	492,476

Month	1921	1922	1923	1924	1925	1926	1927	1928
January	36,226	35,395	44,991	46,165	44,865	45,452	50,059	38,651
February	27,492	38,933	37,042	41,038	32,594	38,826	46,549	35,978
March	27,620	47,665	40,830	34,465	30,845	38,396	52,901	38,034
April	25,453	12,280	36,473	24,328	27,471	32,925	27,952	26,392
May	31,294	16,601	39,840	26,967	29,494	31,900	28,794	30,647
June	32,239	18,580	39,591	27,033	31,481	35,094	30,377	30,294
July	28,890	13,245	39,342	29,170	33,969	36,376	27,492	30,734
August	32,907	23,258	43,394	31,656	39,130	39,331	35,464	35,495
September	33,367	38,221	41,038	37,825	40,791	41,965	35,843	35,707
October	41,543	41,248	44,255	43,174	46,410	47,227	37,801	44,361
November	33,524	40,833	38,308	36,824	43,444	52,424	34,822	40,106
December	28,178	41,670	35,101	40,066	45,027	50,580	35,261	37,162
	378,733	367,929	480,205	418,711	445,521	490,496	443,315	423,561

[a] The figures represent all bituminous coal produced other than that made into coke and therefore include coal-mine fuel, local sales for all purposes other than coke making, and shipments for all purposes other than coke making.

They are obtained by subtracting from the figures of total production for the month the coal equivalent of the beehive and by-product coke made in the same month. This coal equivalent can be computed with great accuracy from the known production of coke. There is, however, a time discrepancy of unknown and varying amount between the coal production series and the coke production series, which arises from the fact that coal charged into by-product ovens must ordinarily be shipped some distance from the mine and that the by-product plants maintain stocks of coal to even up irregularities in their receipts, which stocks fluctuate between 11 and 42 days' supply. The error introduced by this time discrepancy is seldom serious, however, the less so because in the case of beehive coke the production of raw coal and its conversion into coke are one continuous process.

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[11] Tryon, F. G., Monthly Production of Anthracite Coal and Shipments and Production of Beehiva Coke: Rev. of Econ, Statistics, October, 1926, pp. 199–204.

NUMBER AND SIZE OF MINES

TABLE 21.—*Number and production of commercial bituminous coal mines, by size classes, in 1928*

[No canvass of wagon mines was made]

State	Class 1A (more than 500,000 tons)					Class 1B (200,000 to 500,000 tons)					Class 2 (100,000 to 200,000 tons)					Class 3 (50,000 to 100,000 tons)				
	Mines		Production			Mines		Production			Mines		Production			Mines		Production		
	Number	Per cent	Total (net tons)	Average per mine (net tons)	Per cent	Number	Per cent	Total (net tons)	Average per mine (net tons)	Per cent	Number	Per cent	Total (net tons)	Average per mine (net tons)	Per cent	Number	Per cent	Total (net tons)	Average per mine (net tons)	Per cent
Alabama	4	1.9	2,928,442	732,110	16.6	16	7.5	4,906,268	306,642	27.8	32	15.1	4,454,127	139,191	25.3	51	24.1	3,796,279	74,437	21.5
Alaska																1	12.5	62,747	62,747	49.8
Arkansas																11	13.9	829,000	75,364	49.9
Colorado						13	6.1	4,007,667	308,282	40.7	19	8.8	2,483,743	130,723	25.2	29	13.5	2,051,006	70,724	20.8
Georgia																1	100.0	58,390	58,390	100.0
Illinois	33	6.0	28,028,996	849,364	50.1	50	9.1	16,717,512	334,350	29.9	40	7.3	6,038,558	150,964	10.8	37	6.8	2,723,817	73,617	4.9
Indiana	3	1.8	1,714,298	571,433	10.5	31	18.3	9,126,126	294,391	55.7	19	11.2	2,703,458	142,287	16.5	22	13.0	1,514,573	68,844	9.2
Iowa						4	1.8	1,182,582	295,646	32.1	5	2.3	784,590	156,918	21.3	6	2.7	417,609	69,602	11.3
Kansas											6	2.6	706,323	117,721	25.1	8	3.4	623,440	77,930	22.2
Kentucky:																				
Eastern	9	2.3	6,856,995	761,888	15.0	67	17.2	19,806,234	295,615	43.5	66	16.9	9,449,315	143,171	20.7	88	22.6	6,151,260	69,901	13.5
Western	2	1.3	1,089,862	544,931	6.7	27	18.4	7,237,107	268,041	44.5	36	24.5	5,248,755	145,799	32.2	19	12.9	1,328,444	69,918	8.1
Maryland						1	1.2	251,971	251,971	9.4	7	8.7	949,876	135,697	35.4	8	10.0	638,273	79,784	23.7
Michigan						1	14.2	233,563	233,563	37.8	2	28.6	214,580	107,290	34.8	2	28.6	158,951	79,476	25.7
Missouri						2	.9	440,035	220,018	11.8	8	3.7	1,012,358	126,545	27.1	8	3.7	607,168	75,896	16.3
Montana	2	3.2	1,788,107	894,054	53.8	3	4.8	796,818	265,606	24.0	1	1.6	161,499	161,499	4.8	4	6.3	317,561	79,390	9.6
New Mexico						3	7.7	976,862	325,621	36.0	6	15.4	873,154	145,526	32.2	8	20.5	651,534	81,442	24.0
North Dakota						4	2.6	994,144	248,536	60.3	1	.7	148,187	148,187	9.0					
Ohio	1	.2	536,503	536,503	3.4	17	2.7	4,851,721	285,395	31.0	28	4.5	3,896,890	139,175	24.9	31	5.0	2,268,601	73,181	14.5
Oklahoma						1	.7	251,099	251,099	7.2	7	5.1	921,881	131,697	26.3	12	8.8	845,111	70,426	24.1
Pennsylvania	54	3.5	43,601,805	807,441	33.2	135	8.7	41,626,621	308,345	31.7	148	9.5	19,816,572	133,896	15.1	175	11.2	12,348,023	70,560	9.4
Tennessee						8	8.9	2,050,146	256,268	36.5	12	13.3	1,474,264	122,855	26.3	19	21.1	1,360,318	71,596	24.3
Texas						1	3.8	308,994	308,994	26.2	2	7.7	290,928	145,464	24.6	1	3.8	76,500	76,500	6.5
Utah						9	23.7	3,112,149	345,794	64.3	11	28.9	1,420,746	129,159	29.3	2	5.3	112,065	56,033	2.3
Virginia	5	5.8	3,342,482	668,496	28.1	16	18.6	4,690,969	293,186	39.4	18	20.9	2,461,208	136,734	20.7	12	14.0	827,306	68,942	7.0
Washington						6	11.6	1,624,010	270,668	64.4	2	3.8	296,384	148,192	11.8	3	5.8	243,600	81,200	9.7
West Virginia	38	3.9	26,251,096	690,818	19.7	195	19.9	59,159,181	303,380	44.5	199	20.3	29,296,780	147,220	22.0	156	15.9	11,384,587	72,978	8.6
Wyoming	1	1.7	569,242	569,242	8.7	11	19.0	3,188,012	289,819	48.5	12	20.7	1,845,927	153,827	28.1	11	19.0	801,174	72,834	12.2
	152	2.4	116,707,828	767,815	23.3	621	9.6	187,539,791	301,996	37.4	687	10.6	96,950,103	141,121	19.4	725	11.2	52,197,337	71,996	10.4

State	Class 4 (10,000 to 50,000 tons)					Class 5 (less than 10,000 tons)					Total		
	Mines		Production			Mines		Production			Mines	Production (net tons)	
	Number	Per cent	Total (net tons)	Average per mine (net tons)	Per cent	Number	Per cent	Total (net tons)	Average per mine (net tons)	Per cent		Total	Average per mine
Alabama	54	25.5	1,348,697	24,976	7.7	55	25.9	187,549	3,410	1.1	212	17,621,362	83,120
Alaska	2	25.0	62,232	31,116	49.4	5	62.5	1,121	224	.8	8	126,100	15,763
Arizona						4	100.0	3,600	900	100.0	4	3,600	900
Arkansas	25	31.7	627,268	25,091	37.8	43	54.4	204,705	4,761	12.3	79	1,660,973	21,025
California, Idaho, and Oregon	1	20.0	16,000	16,000	67.0	4	80.0	7,888	1,972	33.0	5	23,888	4,778
Colorado	39	18.1	985,327	25,265	10.0	115	53.5	319,964	2,782	3.3	215	9,847,707	45,803
Georgia											1	58,390	58,390
Illinois	65	11.9	1,547,158	23,442	2.7	322	58.9	892,158	2,771	1.6	547	55,948,199	102,282
Indiana	43	25.5	1,129,462	26,267	6.9	51	30.2	190,663	3,738	1.2	169	16,378,580	96,915
Iowa	34	15.3	878,795	25,847	23.9	173	77.9	420,059	2,428	11.4	222	3,683,635	16,593
Kansas	44	19.0	964,568	21,922	34.3	174	75.0	515,393	2,962	18.4	232	2,809,724	12,111
Kentucky:													
Eastern	105	26.9	3,083,089	29,363	6.8	55	14.1	236,270	4,296	.5	390	45,583,163	116,880
Western	46	31.3	1,279,629	27,818	7.9	17	11.6	93,419	5,495	.6	147	16,277,216	110,729
Maryland	23	28.8	712,743	30,989	26.5	41	51.3	134,116	3,271	5.0	80	2,686,979	33,587
Michigan						2	28.6	10,248	5,124	1.7	7	617,342	88,192
Missouri	50	23.0	1,295,257	25,905	34.7	149	68.7	377,603	2,534	10.1	217	3,732,421	17,200
Montana	5	7.9	151,985	30,397	4.6	48	76.2	108,225	2,255	3.2	63	3,324,195	52,765
New Mexico	5	12.8	147,821	29,564	5.5	17	43.6	62,480	3,675	2.3	39	2,711,851	69,535
North Carolina	2	100.0	60,860	30,430	100.0						2	60,860	30,430
North Dakota	12	8.0	262,737	21,895	15.9	133	88.7	244,862	1,841	14.8	150	1,649,930	11,000
Ohio	134	21.6	2,905,696	21,684	18.6	409	66.0	1,181,814	2,890	7.6	620	15,641,225	25,228
Oklahoma	49	35.8	1,260,209	25,719	36.0	68	49.6	223,025	3,280	6.4	137	3,501,325	25,557
Pennsylvania	463	29.7	11,480,771	24,796	8.8	582	37.4	2,328,371	4,001	1.8	1,557	131,202,163	84,266
South Dakota						17	100.0	13,929	819	100.0	17	13,929	819
Tennessee	24	26.7	642,380	26,766	11.4	27	30.0	83,851	3,106	1.5	90	5,610,959	62,344
Texas	19	73.1	487,067	25,635	41.2	3	11.6	18,545	6,182	1.5	26	1,182,034	45,463
Utah	7	18.4	182,854	26,122	3.8	9	23.7	14,730	1,637	.3	38	4,842,544	127,435
Virginia	20	23.3	541,353	27,068	4.5	15	17.4	37,615	2,508	.3	86	11,900,933	138,383
Washington	14	26.9	282,089	20,149	11.2	27	51.9	73,818	2,734	2.9	52	2,519,901	48,460
West Virginia	223	22.8	6,230,289	27,939	4.7	169	17.2	630,226	3,729	.5	980	132,952,159	135,665
Wyoming	5	8.6	128,106	25,621	1.9	18	31.0	39,222	2,179	.6	58	6,571,683	113,305
	1,513	23.5	38,694,442	25,575	7.7	2,752	42.7	8,655,469	3,145	1.8	6,450	500,744,970	77,635

TABLE 22.—*Number and yearly output of commercial bituminous coal mines, by size classes, 1905, 1910, 1913, 1917–1928* [1]

[Exclusive of wagon mines]

Year	Class 1 (more than 200,000 tons) [2]	Class 2 (100,000 to 200,000 tons)	Class 3 (50,000 to 100,000 tons)	Class 4 (10,000 to 50,000 tons)	Class 5 (less than 10,000 tons)	Total
Number of mines:						
1905	411	612	808	1, 514	1, 715	5, 060
1910	618	763	960	1, 568	1, 909	5, 818
1913	694	837	959	1, 558	1, 728	5, 776
1917	792	911	1, 044	1, 996	2, 193	6, 939
1918	821	929	1, 198	2, 636	2, 735	8, 319
1919	550	854	1, 181	2, 784	3, 625	8, 994
1920	701	1, 031	1. 279	3, 160	2, 750	8, 921
1921	482	807	1, 003	2, 346	3, 400	8, 038
1922	416	848	1, 084	3, 139	3, 812	9, 299
1923	748	935	1, 176	2, 742	3, 730	9, 331
1924	646	819	943	2. 047	3, 131	7, 586
1925	714	833	891	1, 969	2, 737	7, 144
1926	823	845	867	1, 912	2, 730	7, 177
1927	779	818	879	1, 831	2, 704	7, 011
1928	773	687	725	1, 513	2, 752	6, 450
Net tons produced:						
1905	126, 499, 000	85, 920, 000	57, 386, 000	38, 995, 000	6, 034, 000	314, 834, 000
1910	191, 519, 000	107, 052, 000	68, 858, 000	42. 282, 000	6, 561, 000	416, 272, 000
1913	241, 463, 000	118, 476, 000	69, 018, 000	42, 292, 000	6, 280, 000	477, 529. 000
1917	285, 366, 000	129, 486, 000	74, 894, 000	51, 596, 000	8, 824, 000	550, 166, 000
1918	281, 267, 000	131, 027, 000	87, 143, 000	67, 453, 000	11, 387, 000	578, 277, 000
1919	174, 848, 000	120, 926, 000	84, 625, 000	71, 334, 000	13, 198, 000	464, 931, 000
1920	237, 468, 000	142, 750, 000	90, 669, 000	82, 129, 000	10, 716, 000	563, 732, 000
1921	162, 438. 000	115, 607, 000	71, 160, 000	56, 099, 000	10, 618, 000	415, 922, 000
1922	131, 876, 000	117, 195, 000	77, 287, 000	77, 203, 000	15, 248, 000	418, 809, 000
1923	265, 869, 000	130, 804, 000	84, 342, 000	68, 769, 000	13, 639, 000	563, 423, 000
1924	237, 338, 000	115, 217, 000	67, 967, 000	52, 606, 000	10, 559, 000	483, 687, 000
1925	279, 190, 000	117, 986, 000	64, 578, 000	48, 900, 000	9, 399, 000	520, 053, 000
1926	333, 047, 000	120, 598, 000	62, 650, 000	47, 616, 000	9, 456, 000	573, 367, 000
1927	283, 654, 000	115, 506, 000	63, 712, 000	45, 987, 000	8, 904, 000	517, 763, 000
1928	304, 248, 000	96, 950, 000	52, 197, 000	38, 694, 000	8, 656, 000	500, 745, 000
Per cent of total number of mines:						
1905	8. 1	12. 1	16. 0	29. 9	33. 9	100. 0
1910	10. 6	13. 1	16. 5	27. 0	32. 8	100. 0
1913	12. 0	14. 5	16. 6	27. 0	29. 9	100. 0
1917	11. 4	13. 2	15. 0	28. 8	31. 6	100. 0
1918	9. 8	11. 2	14. 4	31. 7	32. 9	100. 0
1919	6. 1	9. 5	13. 1	31. 0	40. 3	100. 0
1920	7. 9	11. 6	14. 3	35. 4	30. 8	100. 0
1921	6. 0	10. 0	12. 5	29. 2	42. 3	100. 0
1922	4. 5	9. 1	11. 7	33. 7	41. 0	100. 0
1923	8. 0	10. 0	12. 6	29. 4	40. 0	100. 0
1924	8. 5	10. 8	12. 4	27. 0	41. 3	100. 0
1925	10. 0	11. 6	12. 5	27. 6	38. 3	100. 0
1926	11. 5	11. 8	12. 1	26. 6	38. 0	100. 0
1927	11. 1	11. 7	12. 5	26. 1	38. 6	100. 0
1928	12. 0	10. 6	11. 2	23. 5	42. 7	100. 0
Per cent of total tonnage:						
1905	40. 2	27. 3	18. 2	12. 4	1. 9	100. 0
1910	46. 0	25. 7	16. 5	10. 2	1. 6	100. 0
1913	50. 6	24. 8	14. 4	8. 9	1. 3	100. 0
1917	51. 9	23. 5	13. 6	9. 4	1. 6	100. 0
1918	48. 6	22. 7	15. 1	11. 6	2. 0	100. 0
1919	37. 6	26. 0	18. 2	15. 4	2. 8	100. 0
1920	42. 1	25. 3	16. 1	14. 6	1. 9	100. 0
1921	39. 1	27. 8	17. 1	13. 5	2. 5	100. 0
1922	31. 5	28. 0	18. 5	18. 4	3. 6	100. 0
1923	47. 2	23. 2	15. 0	12. 2	2. 4	100. 0
1924	49. 0	23. 8	14. 1	10. 9	2. 2	100. 0
1925	53. 7	22. 7	12. 4	9. 4	1. 8	100. 0
1926	58. 1	21. 0	10. 9	8. 3	1. 7	100. 0
1927	54. 8	22. 3	12. 3	8. 9	1. 7	100. 0
1928	60. 7	19. 4	10. 4	7. 7	1. 8	100. 0

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[1] This table shows mines, not companies, and should not be confused with other tables that include country banks and many wagon mines shipping by rail.

[2] Figures for 1924–1928 include class 1A and 1B.

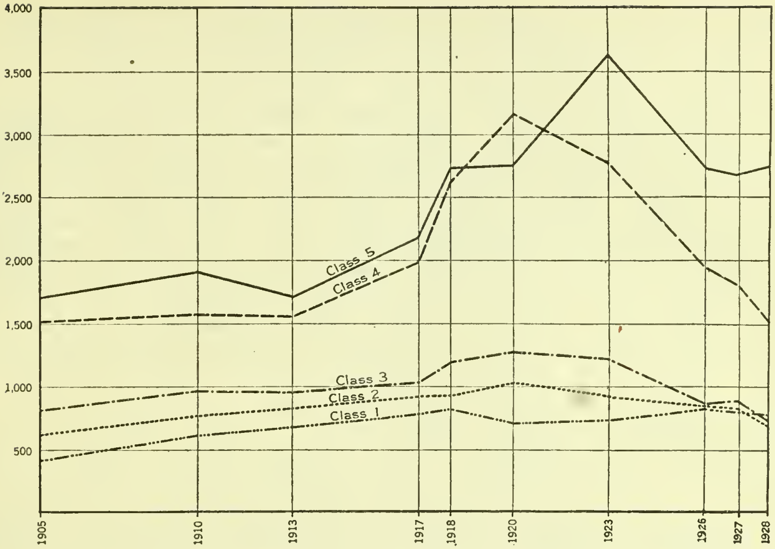

FIGURE 15.—Number of commercial bituminous coal mines in each size class, 1905–1928

TABLE 23.—*Number of mines operating and price of bituminous coal f. o. b. mines, 1913, 1917 and 1928*

Year	Number of commercial bituminous mines in operation	Total number of bituminous mines in operation, including wagon mines	Average spot price f. o. b. mines (Coal Age)	Average sales realization per ton on all coal f. o. b. mines
1913	5,776	(1)	$1.23	$1.18
1917	6,939	10,634	3.25	2.26
1918	8,319	11,038	[2] 2.58	2.58
1919	8,994	12,409	2.59	2.49
1920	8,921	14,766	5.64	3.75
1921	8,038	(1)	2.55	2.89
1922	9,299	14,150	3.64	3.02
1923	9,331	11,715	2.77	2.68
1924	7,586	(1)	2.08	2.20
1925	7,144	(1)	2.06	2.04
1926	7,177	(1)	2.21	2.06
1927	7,011	(1)	1.99	1.99
1928	6,450	(1)	1.80	1.86

[1] Not available.

[2] Price fixed by Fuel Administrator.

VALUE AND PRICES

DEFINITION OF VALUES REPORTED

The value given in this report is the amount received at the mines f. o. b. cars minus the selling expense, and the average value per ton is the average amount received, obtained by dividing the total value by the number of tons sold or produced. Coal used at the mines, coal coked by the producing company, and coal used in some other industry by that company—in all, forming a considerable part of the total output—is not sold, and the value placed upon it is either an estimate or the amount at which it is carried on the company's books. Either value is presumably the amount the coal would have brought if it had been sold or the amount other fuel for the purpose stated would have cost if it had been purchased. In other words, the values given represent returns to the operators for coal sold plus the estimated value of that not sold. The value thus fixed is more or less arbitrary and does not necessarily represent the current prices for coal sold commercially. Many mines are owned by consumers who take all or a great part of their output at nominal prices. The output of such "captive mines" was 22.7 per cent of the entire production in 1926. (Coal in 1926, pp. 473–475.) Even where the coal is actually sold large quantities may be moved on "cost plus" contracts that provide for prices below the average spot prices in the field or the average prices received for coal delivered under ordinary contracts. The figures in the following tables, therefore, do not necessarily show prices or even an average of the prices of coal at the mines. Taken over a period of years, however, they do furnish an index to the rise and fall in the value of coal.

The computed "average value per ton" is thus affected by the value placed by the operator upon coal used at the mine but not shipped. In order to ascertain how large an influence the inclusion of this noncommercial coal might have upon the average, the operators were requested for several years to give separate statements of value for coal loaded at the mines for shipment, for sales to local trade, and for mine fuel and coal made into beehive coke. It was found, however, that for practical purposes the average value of all the coal produced may be accepted as a measure of the average value of the coal shipped. The values placed by operators on mine fuel and upon the coal coked were generally somewhat less than the average amounts received for the coal shipped, but the quantities to which these lower values applied were so much smaller than the quantity shipped that they affected the average for all coal produced only slightly.

ESTIMATES OF VALUE INCLUDED IN STATISTICS

If an operator who is known to have produced coal during the year will make no report of the value of his product to the Bureau of Mines, an estimate of the value is included in the total to make it complete. These estimates are based on the average for each county as obtained from all reports of the operators in the county that did specify value.

Of the $933,774,000 given as the total value of bituminous coal at the mines in 1928, fully $890,580,000 represents actual reports from the operators and $43,194,000 represents estimates made in the manner just described. The proportion actually reported is thus 95.37 per cent of the total, a proportion so high as to indicate that the results are thoroughly representative for the country as a whole. The percentage actually reported in each of the principal States is shown in Table 24.

TABLE 24.—*Per cent of total value of bituminous coal produced by commercial operators that is represented by actual reports from the operators, by States, in 1928*

State	Per cent	State	Per cent
Alabama	92.10	North Dakota	98.63
Arkansas	74.33	Ohio	95.63
Colorado	95.74	Oklahoma	58.72
Illinois	94.47	Pennsylvania	97.05
Indiana	91.27	Tennessee	97.25
Iowa	74.05	Texas	97.04
Kansas	84.05	Utah	87.98
Kentucky	94.42	Virginia	99.75
Maryland	94.44	Washington	99.51
Michigan	100.00	West Virginia	98.23
Missouri	99.42	Wyoming	96.70
Montana	99.79		
New Mexico	99.80	United States	95.37

TABLE 25.—*Total and average value per net ton of coal at mines, by States, 1923 and 1928*

State	Total			Average per net ton		
	1923	1928	Increase or decrease	1923	1928	Increase or decrease
Alabama	$51,624,000	$39,601,000	−$12,023,000	$2.52	$2.25	−$0.27
Alaska	755,000	662,000	−93,000	6.30	5.25	−1.05
Arizona		16,000	+16,000		4.44	
Arkansas	5,192,000	5,615,000	+423,000	4.01	3.38	−.63
California, Idaho, and Oregon	79,000	70,000	−9,000	3.94	2.93	−1.01
Colorado	33,299,000	27,613,000	−5,686,000	3.22	2.80	−.42
Georgia	327,000	181,000	−146,000	4.32	3.10	−1.22
Illinois	198,388,000	112,095,000	−86,293,000	2.50	2.00	−.50
Indiana	65,046,000	29,212,000	−35,834,000	2.48	1.78	−.70
Iowa	20,517,000	10,525,000	−9,992,000	3.59	2.86	−.73
Kansas	14,275,000	6,861,000	−7,414,000	3.21	2.44	−.77
Kentucky	113,542,000	96,722,000	−16,820,000	2.54	1.56	−.98
Maryland	6,911,000	4,954,000	−1,957,000	3.02	1.84	−1.18
Michigan	5,545,000	2,631,000	−2,914,000	4.73	4.26	−.47
Missouri	11,575,000	9,637,000	−1,938,000	3.40	2.58	−.82
Montana	9,652,000	7,550,000	−2,102,000	3.07	2.27	−.80
New Mexico	10,668,000	8,636,000	−2,032,000	3.66	3.18	−.48
North Carolina	132,000	201,000	+69,000	3.66	3.30	−.36
North Dakota	3,275,000	2,780,000	−495,000	2.36	1.68	−.68
Ohio	98,610,000	26,439,000	−72,171,000	2.43	1.69	−.74
Oklahoma	10,874,000	10,365,000	−509,000	3.77	2.96	−.81
Pennsylvania, bituminous	472,217,000	249,895,000	−222,322,000	2.75	1.90	−.85
South Dakota	25,000	39,000	+14,000	2.41	2.80	+.39
Tennessee	16,515,000	9,694,000	−6,821,000	2.73	1.73	−1.00
Texas	2,162,000	1,589,000	−573,000	1.82	1.34	−.48
Utah	13,657,000	12,253,000	−1,404,000	2.89	2.53	−.36
Virginia	32,468,000	20,375,000	−12,093,000	2.76	1.71	−1.05
Washington	10,894,000	8,720,000	−2,174,000	3.72	3.46	−.26
West Virginia	285,481,000	211,480,000	−74,001,000	2.65	1.59	−1.06
Wyoming	20,916,000	17,363,000	−3,553,000	2.76	2.64	−.12
Total bituminous	1,514,621,000	933,774,000	−580,847,000	2.68	1.86	−.82
Pennsylvania anthracite	506,787,000	393,638,000	−113,149,000	5.43	5.22	−.21
Grand total	2,021,408,000	1,327,412,000	−693,996,000	3.07	2.30	−.77

AVERAGE VALUE PER TON

Changes in the average value of coal per net ton from 1880 to 1928 are shown in Table 26. It is noteworthy that the downward trend in sales realizations on bituminous coal, apparent since 1923, continued in 1928. In the latter year the average value per ton was $1.86, a decrease of 13 cents from 1927 and the lowest realization since 1916. The decline in the grand average reflected reductions in comparison with the preceding year in all but five States. (See Table 27.)

The figures of average value collected by the Bureau of Mines are a composite of business covered by contract or trade connections of long standing at stable prices and business on the open market, termed by the trade "spot sales." The spot price reflects the momentary condition of the market as interpreted by the buyer seeking low prices on the one hand and by the seller attempting to place his coal at the maximum profit on the other. Much significance, therefore, attaches to the course of spot prices as an index to the state of trade. (See Table 30.) As indicated in Table 29, however, the spot price should not be taken as a measure of sales realization by the coal producer over any extended period.

TABLE 26.—*Average value per net ton of coal at mines, 1880–1928*

Year	Anthracite [1]	Bituminous	Year	Anthracite [1]	Bituminous	Year	Anthracite [1]	Bituminous
1880	$1.47	$1.25	1897	$1.51	$0.81	1914	$2.07	$1.17
1881	2.01	1.12	1898	1.41	.80	1915	2.07	1.13
1882	2.01	1.12	1899	1.46	.87	1916	2.30	1.32
1883	2.01	1.07	1900	1.49	1.04	1917	2.85	2.26
1884	1.79	.94	1901	1.67	1.05	1918	3.40	2.58
1885	2.00	1.13	1902	1.84	1.12	1919	4.14	2.49
1886	1.95	1.05	1903	2.04	1.24	1920	4.85	3.75
1887	2.01	1.11	1904	1.90	1.10	1921	5.00	2.89
1888	1.91	1.00	1905	1.83	1.06	1922	5.01	3.02
1889	1.44	.99	1906	1.85	1.11	1923	5.43	2.68
1890	1.43	.99	1907	1.91	1.14	1924	5.43	2.20
1891	1.46	.99	1908	1.90	1.12	1925	5.30	2.04
1892	1.57	.99	1909	1.84	1.07	1926	5.62	2.06
1893	1.59	.96	1910	1.90	1.12	1927	5.26	1.99
1894	1.51	.91	1911	1.94	1.11	1928	5.22	1.86
1895	1.41	.86	1912	2.11	1.15			
1896	1.50	.83	1913	2.13	1.18			

[1] Averages for anthracite represent amounts per net ton and include all coal produced.

TABLE 27.—*Average value per net ton of coal at mines, by States, 1913, 1917, 1920, and 1922–1928*

State	1913	1917	1920	1922	1923	1924	1925	1926	1927	1928	
										Average	Increase or decrease from 1927
Alabama	$1.31	$2.27	$3.65	$2.34	$2.52	$2.34	$2.12	$2.29	$2.25	$2.25	------
Alaska	(1)	4.92	5.83	5.43	6.30	5.62	4.89	5.26	5.25	5.25	------
Arkansas	1.76	2.56	4.56	4.14	4.01	4.06	3.96	3.77	3.48	3.38	−$0.10
California [1]	3.45	2.30	4.36	3.87	3.94	4.19	4.75	3.67	2.81	3.13	+.32
Colorado	1.52	2.22	3.49	3.16	3.22	3.05	2.94	2.78	2.78	2.80	+.02
Georgia	1.41	2.53	5.00	4.06	4.32	3.62	3.32	2.89	3.04	3.10	+.06
Illinois	1.14	1.88	3.08	2.89	2.50	2.27	2.19	2.14	2.16	2.00	−.16
Indiana	1.11	1.99	3.16	2.85	2.48	2.16	2.02	1.98	2.03	1.78	−.25
Iowa	1.79	2.35	3.94	3.72	3.59	3.31	3.14	3.07	3.15	2.86	−.29
Kansas	1.67	2.31	3.87	3.66	3.21	3.03	2.88	2.84	2.80	2.44	−.36
Kentucky	1.05	2.17	4.11	3.02	2.54	1.88	1.72	1.74	1.73	1.56	−.17
Maryland	1.24	2.46	4.63	3.37	3.02	2.17	1.97	2.21	2.07	1.84	−.23
Michigan	1.99	3.22	4.93	5.05	4.73	4.33	4.20	4.12	4.31	4.26	−.05
Missouri	1.73	2.43	4.16	3.81	3.40	3.29	3.07	2.98	2.84	2.58	−.26
Montana	1.74	2.11	3.16	3.19	3.07	2.96	2.59	2.46	2.35	2.27	−.08
New Mexico	1.46	1.86	3.68	3.49	3.66	3.51	3.37	3.16	3.13	3.18	+.05
North Carolina	------	------	7.02	4.94	3.66	3.92	4.34	4.19	3.58	3.30	−.28
North Dakota	1.52	1.80	2.87	2.65	2.36	2.06	1.85	1.74	1.70	1.68	−.02
Ohio	1.10	2.48	3.82	3.23	2.43	2.03	1.93	1.96	1.92	1.69	−.23
Oklahoma	2.05	2.81	4.80	4.11	3.77	3.69	3.30	3.18	3.03	2.96	−.07
Oregon	2.53	3.38	4.49	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Pennsylvania, bituminous	1.11	2.44	3.77	3.11	2.75	2.26	2.10	2.13	2.05	1.90	−.15
South Dakota	1.96	2.90	3.60	2.84	2.41	2.99	2.91	2.91	3.04	2.80	−.24
Tennessee	1.14	2.19	4.02	2.89	2.73	2.13	1.85	1.90	1.84	1.73	−.11
Texas	1.77	1.77	3.75	2.32	1.82	1.50	1.55	1.60	1.51	1.34	−.17
Utah	1.65	2.07	3.22	3.14	2.89	2.69	2.56	2.37	2.32	2.53	+.21
Virginia	1.01	2.00	3.99	2.58	2.76	2.04	1.84	1.92	1.80	1.71	−.09
Washington	2.38	2.68	3.88	3.98	3.72	3.65	3.62	3.61	3.50	3.46	−.04
West Virginia	1.01	2.32	4.34	2.93	2.65	1.82	1.71	1.84	1.72	1.59	−.13
Wyoming	1.56	1.93	2.98	3.04	2.76	2.71	2.79	2.74	2.69	2.64	−.05
Total bituminous	1.18	2.26	3.75	3.02	2.68	2.20	2.04	2.06	1.99	1.86	−.13
Pennsylvania anthracite [2]	2.13	2.85	4.85	5.01	5.43	5.43	5.30	5.62	5.26	5.22	−.04

[1] California includes Alaska, 1913; Arizona, 1926–1928; Idaho, 1913–1928; Nebraska, 1924; Nevada, 1927; and Oregon, 1922–1928.

[2] These values represent amounts per net ton and include all coal produced.

AVERAGE EXPORT PRICES

TABLE 28.—*Average value per net ton of bituminous coal exported from the United States to Canada and to all other destinations, by months, 1923–1928*

[Computed from records of Bureau of Foreign and Domestic Commerce. Figures represent value at port, including transportation, and are therefore affected by changes in freight rates as well as f. o. b. mine prices. They include, of course, both spot and contract shipments. Data for 1902 to 1922 were published in Coal in 1923, pp. 624–625]

Month	1923		1924		1925		1926		1927		1928	
	Canada	Overseas and all others	Canada	Overseas and all others	Canada	Overseas and all others	Canada	Overseas and all others	Canada	Overseas and all others	Canada	Overseas and all others
January	$5. 61	$6. 00	$4. 73	$4. 55	$4. 31	$4. 13	$3. 72	$4. 42	$4. 37	$5. 34	$3. 84	$4. 45
February	5. 80	5. 96	4. 64	4. 49	4. 42	4. 25	3. 84	4. 28	4. 17	4. 52	3. 87	4. 21
March	5. 77	5. 75	4. 52	4. 45	3. 98	4. 18	3. 75	4. 16	4. 17	4. 45	3. 81	4. 35
April	5. 38	5. 98	4. 40	4. 41	3. 98	4. 11	4. 00	4. 26	3. 89	4. 37	3. 96	4. 37
May	4. 70	5. 78	4. 01	4. 47	3. 72	4. 06	3. 74	4. 25	3. 63	4. 36	3. 63	4. 33
June	4. 51	5. 18	3. 66	4. 46	3. 85	4. 10	3. 73	4. 28	3. 61	4. 26	3. 56	4. 14
July	4. 40	5. 10	3. 68	4. 48	3. 77	4. 06	3. 81	4. 35	3. 62	4. 21	3. 52	4. 15
August	4. 35	4. 92	3. 83	4. 37	3. 84	4. 08	3. 85	4. 37	3. 59	4. 22	3. 45	4. 11
September	4. 50	5. 04	3. 76	4. 19	3. 61	4. 28	3. 70	4. 49	3. 70	4. 27	3. 47	4. 12
October	4. 47	4. 69	3. 91	4. 24	3. 72	4. 23	3. 76	4. 71	3. 62	4. 29	3. 42	4. 31
November	4. 39	4. 59	4. 17	4. 32	3. 79	4. 25	3. 90	5. 47	3. 69	4. 34	3. 48	4. 21
December	4. 59	4. 45	4. 16	4. 27	3. 77	4. 38	4. 10	5. 51	4. 01	4. 29	3. 81	4. 06
Average	4. 76	5. 30	4. 06	4. 40	3. 84	4. 16	3. 83	4. 79	3. 81	4. 60	3. 59	4. 23

SPOT PRICES

TABLE 29.—*Average spot price and average amount received per ton for bituminous coal, 1906–1928*

Year	Coal Age's average spot price	Average amount received	Difference [1]	Year	Coal Age's average spot price	Average amount received	Difference [1]
1906	$1. 21	$1. 11	+$0. 10	1918	$2. 58	$2. 58	
1907	1. 18	1. 14	+. 04	1919	2. 59	2. 49	+$0. 10
1908	1. 05	1. 12	−. 07	1920	5. 64	3. 75	+1. 89
1909	1. 04	1. 07	−. 03	1921	2. 55	2. 89	−. 34
1910	1. 23	1. 12	+. 11	1922	3. 64	3. 02	+. 62
1911	1. 07	1. 11	−. 04	1923	2. 77	2. 68	+. 09
1912	1. 21	1. 15	+. 06	1924	2. 08	2. 20	−. 12
1913	1. 23	1. 18	+. 05	1925	2. 06	2. 04	+. 02
1914	1. 14	1. 17	−. 03	1926	2. 21	2. 06	+. 15
1915	1. 12	1. 13	−. 01	1927	1. 99	1. 99	
1916	1. 85	1. 32	+. 53	1928	1. 80	1. 86	−. 06
1917	3. 25	2. 26	+. 99				
				Average 23 years	2. 02	1. 85	+. 17

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[1] A plus sign indicates that the spot price was greater than the average amount received, and a minus sign indicates that it was less than the average amount received.

TABLE 30.—*Monthly average spot price of bituminous coal f. o. b. mines, 1909–1928, as published by Coal Age*

[Figures are average of trade-journal quotations on 14 coals representative of nearly 90 per cent of the bituminous output of the United States, weighted, first, with respect to the proportions each of slack, prepared, and run-of-mine normally shipped, and, second, with respect to the tonnage of each normally produced. For 1919 to 1928 the figures are those published currently by Coal Age, based upon the reports of its field correspondents. For 1913 to 1918 they are taken from Prices of Coal and Coke, by C. E. Lesher, published in 1919 as a chapter of Mineral Resources of the United States, 1918, and also separately by the Fuel Administration and the War Industries Board, modified slightly, however, to permit comparison with the postwar quotations. For 1909 to 1912 they are taken from a study by F. G. Tryon and W. F. McKenney, compiled in as nearly the same way as the trade-journal quotations available permit and representing 12 or 14 coals covered by the later series]

Month	1909	1910	1911	1912	1913	1914	1915	1916	1917	1918
January	$1.06	$1.24	$1.16	$1.14	$1.46	$1.21	$1.13	$1.53	$4.15	$2.48
February	1.05	1.23	1.11	1.22	1.22	1.16	1.12	1.40	4.18	2.53
March	1.04	1.25	1.08	1.64	1.17	1.17	1.09	1.27	3.89	2.58
April	1.05	1.26	1.06	1.30	1.17	1.16	1.08	1.24	3.21	2.64
May	1.03	1.19	1.05	1.11	1.15	1.16	1.07	1.21	4.14	2.67
June	1.02	1.18	1.05	1.09	1.14	1.12	1.07	1.26	4.00	2.57
July	1.00	1.18	1.03	1.04	1.18	1.12	1.05	1.22	3.17	2.58
August	1.00	1.20	1.02	1.05	1.22	1.13	1.07	1.30	3.24	2.58
September	1.01	1.32	1.03	1.09	1.23	1.11	1.10	1.57	2.02	2.58
October	1.04	1.27	1.04	1.21	1.29	1.13	1.12	2.26	2.02	2.58
November	1.09	1.23	1.09	1.30	1.31	1.10	1.17	3.87	2.48	2.58
December	1.09	1.22	1.09	1.29	1.26	1.11	1.33	4.01	2.48	2.58
Average	1.04	1.23	1.07	1.21	1.23	1.14	1.12	1.85	3.25	2.58

Month	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928
January	$2.57	$2.57	$3.26	$2.25	$4.38	$2.21	$2.10	$2.18	$2.34	$1.85
February	2.49	2.58	2.77	2.20	3.59	2.25	2.04	2.09	2.11	1.86
March	2.47	2.58	2.63	2.12	3.20	2.15	1.99	2.01	2.06	1.91
April	2.43	3.85	2.62	2.24	2.84	2.07	1.95	1.92	1.93	1.74
May	2.38	4.59	2.68	3.11	2.68	2.04	1.97	1.93	1.87	1.73
June	2.40	7.18	2.52	3.31	2.56	2.03	1.95	1.90	1.85	1.73
July	2.47	8.24	2.40	4.67	2.40	1.98	1.93	1.91	1.87	1.71
August	2.76	9.51	2.42	6.13	2.39	1.99	2.04	2.00	2.06	1.74
September	2.91	8.52	2.37	5.08	2.46	2.02	2.18	2.15	2.07	1.81
October	3.09	7.78	2.33	4.48	2.28	2.10	2.13	2.70	1.96	1.83
November	2.57	5.87	2.35	4.11	2.25	2.06	2.26	3.19	1.90	1.85
December	2.58	4.38	2.26	4.05	2.18	2.06	2.19	2.53	1.90	1.85
Average	2.59	5.64	2.55	3.64	2.77	2.08	2.06	2.21	1.99	1.80

LABOR STATISTICS

MEN EMPLOYED

The method of collecting employment statistics is explained in detail in Coal in 1925, pages 428 to 431. These statistics are believed to represent the most accurate returns obtainable under present conditions, both as to the records generally available in mine offices and as to the funds allotted to the Bureau of Mines for collecting data.

As previously noted, 522,150 men were employed at bituminous coal mines in 1928, a decrease of 71,768 workers from the preceding year. The number of employees reached a maximum in 1923, when 704,793 men were reported. In comparison with the latter figure the labor force in 1928 represents a decrease of 25.9 per cent. The extent to which the recent reductions affected mine workers in most of the important coal-producing States is indicated in Table 31.

Of the total labor force employed in 1928, 63.1 per cent was engaged directly in the business of winning the coal, 23.3 per cent served this first group underground in some way or other, and 13.6 per cent was at work on the surface. During the past 10 years the proportion of workers underground has steadily increased, with a corresponding decline in the proportion of surface employees. (See Table 32.) There is, however, a wide variation in the ratios of underground and surface men in different States and under different mining conditions, as is readily seen from Table 33.

TABLE 31.—*Comparative number of employees in coal mines, by States, 1923, 1926, 1927, and 1928*

State	Average number employed				Per cent of increase or decrease		
	1923	1926	1927	1928	1923–1928	1926–1928	1927–1928
Alabama	30, 035	27, 345	27, 615	25, 708	−14. 4	−6. 0	−6. 9
Arkansas	3, 754	3, 589	3, 706	4, 092	+9. 0	+14. 0	+10. 4
Colorado	13, 340	12, 815	11, 999	12, 366	−7. 3	−3. 5	+3. 1
Illinois	99, 714	75, 870	76, 970	64, 266	−35. 5	−15. 3	−16. 5
Indiana	35, 408	23, 404	24, 352	16, 806	−52. 5	−28. 2	−31. 0
Iowa	11, 448	8, 869	8, 741	6, 965	−39. 2	−21. 5	−20. 3
Kansas	9, 761	8, 172	7, 004	5, 991	−38. 6	−26. 7	−14. 5
Kentucky	60, 811	60, 578	64, 747	62, 195	+2. 3	+2. 7	−3. 9
Maryland	3, 725	3, 681	3, 459	3, 304	−11. 3	−10. 2	−4. 5
Michigan	1, 977	1, 573	1, 512	1, 239	−37. 3	−21. 2	−18. 1
Missouri	6, 952	5, 270	6, 232	5, 964	−14. 2	+13. 2	−4. 3
Montana	3, 511	2, 419	2, 281	2, 191	−37. 6	−9. 4	−3. 9
New Mexico	4, 095	3, 167	3, 456	3, 441	−16. 0	+8. 7	−. 4
North Dakota	1, 621	1, 288	1, 341	1, 335	−17. 6	+3. 6	−. 4
Ohio	54, 555	38, 547	35, 543	21, 371	−60. 8	−44. 6	−39. 9
Oklahoma	7, 130	5, 400	5, 796	6, 218	−12. 8	+15. 1	+7. 3
Pennsylvania, bituminous	194, 981	155, 999	153, 699	133, 414	−31. 6	−14. 5	−13. 2
Tennessee	11, 244	7, 948	7, 691	7, 849	−30. 2	−1. 2	+2. 1
Texas	2, 452	1, 650	1, 674	1, 462	−40. 4	−11. 4	−12. 7
Utah	4, 381	3, 545	3, 339	3, 352	−23. 5	−5. 4	+. 4
Virginia	14, 120	13, 764	13, 211	12, 312	−12. 8	−10. 5	−6. 8
Washington	4, 306	3, 609	3, 407	3, 099	−28. 0	−14. 1	−9. 0
West Virginia	117, 300	118, 726	119, 799	111, 733	−4. 7	−5. 9	−6. 7
Wyoming	7, 529	5, 862	5, 791	4, 843	−35. 7	−17. 4	−16. 4
Other States [1]	643	557	553	634	−1. 4	+13. 8	+14. 6
Total bituminous	704, 793	593, 647	593, 918	522, 150	−25. 9	−12. 0	−12. 1
Pennsylvania anthracite	157, 743	165, 386	165, 259	160, 681	+1. 9	−2. 8	−2. 8
Grand total	862, 536	759, 033	759, 177	682, 831	−20. 8	−10. 0	−10. 1

[1] Includes Alaska, Arizona (1926, 1927, and 1928), California, Georgia, Idaho, Nebraska (1924), Nevada (1927), North Carolina, Oregon, and South Dakota.

TABLE 32.—*Men employed underground and on the surface in coal mines, 1919–1928*

[Corresponding data for the years 1911 to 1918 will be found in Coal in 1926, p. 476]

Year	Underground						Surface		Total number
	Miners, loaders, and shot firers		All others [1]		Total underground				
	Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent	
Anthracite:									
1919	(2)	(2)	(2)	(2)	107, 829	69. 8	46, 742	30. 2	154, 571
1920	63, 339	43. 6	37, 684	26. 1	101, 023	69. 7	44, 051	30. 3	145, 074
1921	73, 977	46. 4	42, 840	26. 8	116, 817	73. 2	42, 682	26. 8	159, 499
1922	72, 527	46. 2	41, 752	26. 6	114, 279	72. 8	42, 570	27. 2	156, 849
1923	72, 362	45. 9	42, 359	26. 8	114, 721	72. 7	43, 022	27. 3	157, 743
1924	76, 035	47. 5	43, 328	27. 1	119, 363	74. 6	40, 646	25. 4	160, 009
1925	78, 773	49. 1	41, 795	26. 1	120, 568	75. 2	39, 744	24. 8	160, 312
1926	81, 963	49. 5	44, 268	26. 8	126, 231	76. 3	39, 155	23. 7	165, 386
1927	82, 583	50. 0	44, 614	27. 0	127, 197	77. 0	38, 062	23. 0	165, 259
1928	81, 627	50. 8	42, 269	26. 3	123, 896	77. 1	36, 785	22. 9	160, 681
Bituminous:									
1919	(2)	(2)	(2)	(2)	508, 801	81. 8	113, 197	18. 2	621, 998
1920	355, 660	55. 5	174, 152	27. 3	529, 812	82. 8	109, 735	17. 2	639, 547
1921	399, 270	60. 1	168, 019	25. 4	567, 289	85. 5	96, 465	14. 5	663, 754
1922	407, 772	59. 3	174, 637	25. 3	582, 409	84. 6	105, 549	15. 4	687, 958
1923	422, 040	59. 9	178, 265	25. 3	600, 305	85. 2	104, 488	14. 8	704, 793
1924	380, 324	61. 4	151, 580	24. 4	531, 904	85. 8	87, 700	14. 2	619, 604
1925	367, 456	62. 5	139, 085	23. 6	506, 541	86. 1	81, 952	13. 9	588, 493
1926	370, 292	62. 3	140, 532	23. 7	510, 824	86. 0	82, 823	14. 0	593, 647
1927	372, 565	62. 7	139, 541	23. 5	512, 106	86. 2	81, 812	13. 8	593, 918
1928	329, 364	63. 1	121, 596	23. 3	450, 960	86. 4	71, 190	13. 6	522, 150

[1] Includes haulage and trackmen.

[2] No data.

TABLE 33.—*Men employed in coal mines, by States, in 1928*

State	Underground						Surface		Total number
	Miners, loaders, and shot firers		Haulage and track		All others				
	Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent	
Alabama	15,566	60.6	2,992	11.6	3,192	12.4	3,958	15.4	25,708
Alaska	51	38.3	10	7.5	24	18.1	48	36.1	133
Arizona	11	91.7					1	8.3	12
Arkansas	2,620	64.0	432	10.5	379	9.3	661	16.2	4,092
California, Idaho, and Oregon	43	51.2	7	8.3	16	19.1	18	21.4	84
Colorado	7,994	64.6	1,463	11.8	1,097	8.9	1,812	14.7	12,366
Georgia							124	100.0	124
Illinois	43,718	68.0	7,130	11.1	6,681	10.4	6,737	10.5	64,266
Indiana	9,967	59.3	1,859	11.1	1,735	10.3	3,245	19.3	16,806
Iowa	5,055	72.6	766	11.0	644	9.2	500	7.2	6,965
Kansas	4,153	69.3	446	7.4	261	4.4	1,131	18.9	5,991
Kentucky	37,801	60.8	7,383	11.9	8,460	13.6	8,551	13.7	62,195
Maryland	2,225	67.4	387	11.7	311	9.4	381	11.5	3,304
Michigan	818	66.0	174	14.0	127	10.3	120	9.7	1,239
Missouri	3,697	62.0	421	7.1	448	7.5	1,398	23.4	5,964
Montana	1,319	60.2	282	12.9	200	9.1	390	17.8	2,191
New Mexico	2,142	62.2	377	11.0	319	9.3	603	17.5	3,441
North Carolina	160	66.7	32	13.3	16	6.7	32	13.3	240
North Dakota	803	60.1	78	5.9	55	4.1	399	29.9	1,335
Ohio	14,151	66.2	1,937	9.1	2,317	10.8	2,966	13.9	21,371
Oklahoma	3,796	61.0	662	10.7	631	10.1	1,129	18.2	6,218
Pennsylvania, bituminous	90,036	67.5	13,588	10.2	13,729	10.3	16,061	12.0	133,414
South Dakota	41	100.0							41
Tennessee	4,951	63.1	930	11.8	818	10.4	1,150	14.7	7,849
Texas	974	66.6	161	11.0	113	7.8	214	14.6	1,462
Utah	2,071	61.8	417	12.5	323	9.6	541	16.1	3,352
Virginia	6,293	51.1	1,766	14.3	2,445	19.9	1,808	14.7	12,312
Washington	1,951	63.0	284	9.2	367	11.8	497	16.0	3,099
West Virginia	64,045	57.3	16,589	14.9	15,197	13.6	15,902	14.2	111,733
Wyoming	2,912	60.1	686	14.2	432	8.9	813	16.8	4,843
Total bituminous	329,364	63.1	61,259	11.7	60,337	11.6	71,190	13.6	522,150
Pennsylvania anthracite	81,627	50.8	16,183	10.1	26,086	16.2	36,785	22.9	160,681
Grand total	410,991	60.2	77,442	11.3	86,423	12.7	107,975	15.8	682,831

DAYS WORKED BY MINES

With the exception of 1926 the average number of days worked at bituminous-coal mines of the country in 1928 was the largest for any year since 1920. Despite the smaller production the mines worked an average of 203 days, a gain of 12 days over 1927. Moreover, although there was considerable variation in the steadiness of employment among the different coal-producing States these differences were not so marked as in 1927. For example, in the latter year the mines of 7 States worked less than an average of 150 days, while those of 14 States worked more than 200 days; in 1928, 13 States worked more than 200 days and only 3 States less than 150 days. (See Table 34.)

TABLE 34.—*Average number of days worked by coal mines, by States, 1919–1928*

State	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928
Alabama	239	247	166	215	232	220	246	266	231	222
Alaska	280	240	244	147	220	287	243	221	229	224
Arizona	------	------	------	------	------	------	------	90	156	208
Arkansas	136	176	112	81	97	134	112	135	137	146
California [1]	59	181	149	250	206	156	174	103	208	177
Colorado	225	255	164	191	174	178	192	202	196	193
Georgia	284	294	183	242	231	248	220	253	250	280
Illinois	160	213	152	120	158	148	161	172	114	156
Indiana	148	192	128	110	136	136	159	173	120	150
Iowa	176	250	148	131	181	161	153	183	114	175
Kansas	182	204	137	125	139	151	169	158	138	128
Kentucky	189	182	152	140	152	174	206	230	237	212
Maryland	179	207	120	101	178	173	209	235	220	233
Michigan	179	261	196	162	222	178	186	171	188	187
Missouri	175	233	166	113	155	135	166	174	151	180
Montana	194	250	143	140	179	173	171	162	197	191
New Mexico	273	302	150	216	216	204	202	251	251	213
North Carolina	100	288	300	167	275	287	272	292	284	180
North Dakota	216	218	194	175	182	165	153	162	168	177
Ohio	164	188	134	100	150	143	151	159	98	171
Oklahoma	184	217	141	114	133	124	153	183	197	169
Oregon	259	307	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Pennsylvania, bituminous	218	244	151	154	213	180	200	224	203	218
South Dakota	164	133	129	138	122	138	143	127	125	128
Tennessee	201	234	154	163	183	159	211	234	235	226
Texas	227	242	139	185	178	166	150	195	202	203
Utah	239	252	151	204	160	182	179	186	209	191
Virginia	247	262	166	198	212	226	254	263	238	226
Washington	217	260	159	194	213	202	193	198	210	220
West Virginia	200	198	149	143	169	182	225	247	235	223
Wyoming	221	264	167	128	192	176	178	181	189	214
Total bituminous	195	220	149	142	179	171	195	215	191	203
Pennsylvania anthracite	266	271	271	151	268	274	182	244	225	217
Grand total	209	230	173	144	195	192	192	221	199	206

[1] California includes Idaho, 1919–1928; Oregon, 1921–1928; Nebraska in 1924; and Nevada in 1927.

LENGTH OF WORKING DAY

ESTABLISHED WORKING DAY

The established working day in the coal mines of the United States is now generally eight hours. When market and other conditions permit, the mines work six days a week, and the established working week is 48 hours. In each year of the past decade more than 93 per cent of the men have been employed in 8-hour mines. (See Table 36.) As indicated in Table 35, the greater proportion of the 9 and 10 hour mines in 1928 was in the fields east of the Mississippi and south of the Ohio and Potomac Rivers.

TABLE 35.—*Number of bituminous-coal mines having established working day of certain length and number of men employed in 1928*

State	8 hours [1]		9 hours		10 hours		All others [2]		Total	
	Mines	Men	Mines	Men	Mines	Men	Mines	Men	Mines	Men
Alabama	77	6,534	85	15,560	23	2,230	27	1,384	212	25,708
Alaska	------	------	------	------	------	------	8	133	8	133
Arkansas	79	4,092	------	------	------	------	------	------	79	4,092
Arizona, California, Idaho, and Oregon	6	86	------	------	------	------	3	10	9	96
Colorado	140	11,908	2	180	------	------	73	278	215	12,366
Georgia	1	124	------	------	------	------	------	------	1	124
Illinois	340	63,286	2	13	------	------	205	967	547	64,266
Indiana	144	16,512	1	23	------	------	24	271	169	16,806
Iowa	121	6,553	------	------	------	------	101	412	222	6,965
Kansas	131	5,519	4	44	------	------	97	428	232	5,991
Kentucky	482	55,990	27	5,324	11	377	17	504	537	62,195
Maryland	59	2,970	1	32	------	------	20	302	80	3,304
Michigan	7	1,239	------	------	------	------	------	------	7	1,239
Missouri	152	5,506	4	129	2	74	59	255	217	5,964
Montana	34	2,022	------	------	------	------	29	169	63	2,191
New Mexico	32	3,413	------	------	------	------	7	28	39	3,441
North Carolina	1	120	------	------	1	120	------	------	2	240
North Dakota	36	793	2	43	2	120	110	379	150	1,335
Ohio	340	19,529	2	24	------	------	278	1,818	620	21,371
Oklahoma	110	5,684	9	460	------	------	18	74	137	6,218
Pennsylvania	1,373	128,717	44	2,720	------	------	140	1,977	1,557	133,414
South Dakota	------	------	------	------	------	------	17	41	17	41
Tennessee	76	6,874	5	463	3	447	6	65	90	7,849
Texas	12	664	11	525	1	233	2	40	26	1,462
Utah	35	3,342	------	------	------	------	3	10	38	3,352
Virginia	81	11,871	3	377	1	54	1	10	86	12,312
Washington	39	3,048	------	------	------	------	13	51	52	3,099
West Virginia	887	105,325	35	5,406	7	432	51	570	980	111,733
Wyoming	50	4,822	------	------	------	------	8	21	58	4,843
	4,845	476,543	237	31,323	51	4,087	1,317	10,197	6,450	522,150

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[1] Includes outside employees working 9 or 10 hours a day at many mines where the established time for underground workers is 8 hours.

[2] Includes employees in mines where the established working day was changed during year, or where the working day was irregular, or which failed to answer the inquiry.

TABLE 36.—*Per cent of men employed in bituminous-coal mines that had established working days of 8, 9, and 10 hours, 1905–1928* [1]

Year	Per cent of total employees in—			Weighted average working day (hours)	Year	Per cent of total employees in—			Weighted average working day (hours)
	8-hour mines	9-hour mines	10-hour mines			8-hour mines	9-hour mines	10-hour mines	
1905	61.1	13.6	25.3	8.6	1918	90.6	6.7	2.7	8.12
1906	63.0	13.5	23.5	8.6	1919	95.5	3.5	1.0	8.06
1907	64.0	11.6	24.4	8.6	1920	97.1	2.0	.9	8.04
1908	63.5	11.1	25.4	8.6	1921	96.6	2.9	.5	8.04
1910	62.1	11.3	26.6	8.6	1922	95.1	4.0	.9	8.06
1911	62.9	10.9	26.2	8.6	1923	94.7	4.2	1.1	8.06
1912	61.6	11.5	26.9	8.6	1924	93.7	5.1	1.2	8.08
1913	61.9	15.2	22.9	8.6	1925	93.5	5.4	1.1	8.08
1914	60.7	15.4	23.9	8.6	1926	93.7	5.5	.8	8.07
1915	59.6	17.0	23.4	8.6	1927	93.4	5.6	1.0	8.08
1916	58.6	17.4	24.0	8.6	1928	93.1	6.1	.8	8.08
1917	79.0	12.6	8.4	8.3					

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[1] Calculated on base of total number of men in mines definitely reported as having 8, 9, or 10 hour day. A small number of mines that work more than 10 hours or less than 8 hours have been excluded, as have also all mines for which the reports were defective or which changed their working day during the year.

AVERAGE TIME SPENT UNDERGROUND

In discussing the length of the working day in the coal mines it is necessary to distinguish between the established working day and the time actually spent at work. The established working day does not of itself measure the length of time the men actually work, because the mine may shut down before the full day is out, because the miner may go home before the mine stops, and because he spends a certain amount of time going to and from his place of work underground. Allowing for these other factors, how much time does the man actually spend at work and how long is he underground?

As interpreted in the union wage agreements, the 8-hour day means eight hours of labor at the usual working place, exclusive of time for lunch and exclusive of time spent in going from the entrance of the mine to the working place and back again. In general, this provision applies both to pieceworkers and day-wage workers underground, although certain classes of daymen have duties to be performed outside the eight hours. Motormen and drivers are ordinarily required to take motors and mules on their own time to and from the stables and the parting or station where they begin hauling, and this time is not counted as part of the day's labor.

Although the wage agreements specify eight hours of labor, it does not follow that men are always at work eight hours in the day. Shortage of railroad cars at the tipple, lack of orders, a petty strike, or a breakdown within the mine may cause it to stop work before the eight hours are over. Time workers may lose fractional days through sickness or accident. In particular, the tonnage men, who constitute 40 to 70 per cent of the working force, may leave early before the mine as a whole stops work, because the custom of the industry allows them that freedom. Only in the rarest instances is a record kept of the time these men are in the mine. Sometimes they leave because they have finished their allotted work for the day, sometimes because they feel sick or have other interests to attend to, or sometimes simply because they have earned enough for one day. The amount and the causes of this early quitting have been a subject of discussion and even of controversy between operators and employees.

The nominal working day, therefore, measures neither the length of time spent by the men at work nor the length of time they are underground, and it was not until recently that any figures on these points were available. In connection with its periodic surveys of miners' earnings, the Bureau of Labor Statistics arranged to have a special record kept of the time actually spent in the mine by many thousands of tonnage men during typical biweekly pay periods. The results, which show the time spent at the working place and also the total time in the mine, will be found in publications of the Bureau of Labor Statistics, United States Department of Labor, as follows: Monthly Labor Review for July, 1925, pages 68 to 87, and for February, 1926, pages 77 to 87, and Bulletins 316, 416, and 454.

OUTPUT PER MAN

TABLE 37.—*Coal produced per man per day and per year, by States, 1919–1928, in net tons*

State	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928
Per man per day:										
Alabama	2.42	2.56	2.93	3.01	2.93	3.11	3.00	2.89	3.10	3.09
Arkansas	2.76	2.94	3.03	3.32	3.39	3.24	2.99	3.00	3.05	2.79
Colorado	3.88	3.51	3.83	3.87	[1] 4.45	[1] 4.52	[1] 4.07	[1] 4.11	[1] 4.13	[1] 4.13
Illinois	4.48	4.78	4.80	5.05	5.02	5.16	5.33	5.31	5.36	5.57
Indiana	4.72	4.86	4.86	5.19	5.43	5.75	5.89	5.72	6.13	6.51
Iowa	2.59	2.61	2.69	2.55	2.75	2.80	3.02	2.85	2.96	3.02
Kansas	2.89	3.19	3.08	3.02	3.19	3.29	3.44	3.43	3.57	3.68
Kentucky	3.49	3.95	4.11	4.89	4.83	4.67	4.68	4.52	4.50	4.69
Maryland	3.13	3.50	3.27	3.15	3.42	3.27	3.61	3.56	3.70	3.50
Michigan	2.65	2.65	2.63	2.65	2.67	3.00	2.75	2.55	2.67	2.67
Missouri	2.44	2.56	2.50	2.88	3.07	3.08	3.18	3.27	3.26	3.47
Montana	4.05	4.19	4.57	5.03	5.00	5.26	6.64	7.14	6.99	7.93
New Mexico	3.07	3.26	3.58	3.61	3.28	3.25	3.68	3.54	3.38	3.70
North Dakota	3.63	3.75	4.19	4.39	4.60	5.62	6.61	6.56	6.78	7.00
Ohio	4.41	4.73	4.60	4.92	4.95	4.82	4.67	4.56	4.52	4.28
Oklahoma	2.45	2.70	2.70	3.12	2.99	3.05	2.70	2.88	3.35	3.34
Pennsylvania, bituminous	3.96	3.96	4.03	3.84	4.15	4.27	4.36	4.37	4.26	4.52
Tennessee	2.25	2.48	2.80	2.59	2.93	3.05	3.11	3.11	3.20	3.16
Texas	2.03	2.26	2.42	2.10	2.72	3.16	3.19	3.39	3.92	3.99
Utah [1]	5.03	5.29	6.10	5.18	6.73	5.70	5.90	6.65	6.84	7.57
Virginia	3.26	3.06	3.78	3.93	3.92	3.73	3.69	3.91	4.11	4.28
Washington	2.74	2.89	3.52	2.96	3.19	3.41	3.52	3.62	3.68	3.70
West Virginia	4.18	4.39	4.79	5.10	5.44	5.48	4.94	4.90	5.15	5.35
Wyoming	4.48	4.69	5.08	5.15	5.23	5.41	5.90	6.15	6.18	6.34
Total bituminous	3.84	4.00	4.20	4.28	4.47	4.56	4.52	4.50	4.55	4.73
Pennsylvania anthracite	2.14	[2] 2.28	2.09	[2] 2.31	2.21	2.00	2.12	2.09	2.15	2.17
Grand total	3.41	3.65	3.55	3.89	3.91	3.81	4.04	3.92	3.96	4.10
Per man per year:										
Alabama	578	632	487	647	680	684	738	768	716	685
Arkansas	375	517	340	269	329	433	335	407	418	406
Colorado	873	895	628	740	774	806	781	830	810	796
Illinois	716	1,018	729	606	795	765	860	914	609	871
Indiana	698	934	622	571	738	779	934	991	737	975
Iowa	455	653	398	334	498	452	464	522	337	529
Kansas	526	650	422	377	443	496	580	540	492	469
Kentucky	659	718	625	684	735	810	966	1,039	1,068	995
Maryland	560	726	392	318	608	565	753	836	814	813
Michigan	474	691	516	429	593	536	512	437	501	498
Missouri	427	596	415	326	477	415	527	571	492	626
Montana	785	1,048	654	704	896	909	1,136	1,157	1,378	1,517
New Mexico	838	985	536	779	708	662	742	890	849	788
North Dakota	784	818	813	769	837	925	1,013	1,064	1,139	1,236
Ohio	723	890	617	492	742	689	707	723	445	732
Oklahoma	450	586	380	356	398	379	413	526	659	563
Pennsylvania, bituminous	864	966	609	592	882	772	873	981	865	983
Tennessee	452	580	431	422	536	487	656	728	752	715
Texas	461	547	336	389	484	523	478	661	793	809
Utah	1,201	1,333	922	1,057	1,077	1,037	1,056	1,234	1,432	1,445
Virginia	805	803	628	779	832	843	936	1,027	978	967
Washington	594	752	560	575	680	688	681	717	773	813
West Virginia	835	869	715	729	919	995	1,111	1,209	1,211	1,190
Wyoming	991	1,237	849	659	1,004	950	1,051	1,111	1,166	1,357
Total bituminous	749	881	627	609	801	781	884	966	872	959
Pennsylvania anthracite	570	[2] 618	567	[2] 349	592	550	386	511	485	469
Grand total	713	839	615	565	763	733	777	867	788	844

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[1] Probably too high because of practice common in some districts of men going into mine to shoot coal and load mine cars on days when tipples or mines, as a whole, are not in operation.

[2] Heavy washery output.

TABLE 38.—*Bituminous coal produced underground per man employed underground, by States, in 1928*

State	Total tons mined underground	Total number underground men	Average number days worked	Average tons per underground man	
				Per year	Per day
Alabama	17,288,176	21,750	222	795	3.58
Alaska	126,100	85	224	1,484	6.63
Arkansas	1,553,809	3,431	146	453	3.10
Colorado	9,847,707	10,554	193	933	4.83
Illinois	51,608,757	57,529	156	897	5.75
Indiana	11,555,568	13,561	150	852	5.68
Iowa	3,683,635	6,465	175	570	3.26
Kansas	1,603,304	4,860	128	330	2.58
Kentucky	61,158,760	53,644	212	1,140	5.38
Maryland	2,686,979	2,923	233	919	3.94
Michigan	617,342	1,119	187	552	2.95
Missouri	1,953,914	4,566	180	428	2.38
Montana	2,143,191	1,801	191	1,190	6.23
New Mexico	2,711,851	2,838	213	956	4.49
North Carolina	60,860	208	180	293	1.63
North Dakota	893,799	936	177	955	5.40
Ohio	13,267,521	18,405	171	721	4.22
Oklahoma	2,984,803	5,089	169	587	3.47
Pennsylvania	130,125,292	117,353	218	1,109	5.09
South Dakota	13,929	41	128	340	2.66
Tennessee	5,525,531	6,699	226	825	3.65
Texas	851,435	1,248	203	682	3.36
Utah	4,842,544	2,811	191	1,723	9.02
Virginia	11,900,933	10,504	226	1,133	5.01
Washington	2,519,901	2,602	220	968	4.40
West Virginia	132,903,350	95,831	223	1,387	6.22
Wyoming	6,499,914	4,030	214	1,613	7.54
Other States	27,488	77	181	357	1.97
	480,956,393	450,960	203	1,067	5.26

TABLE 39.—*Coal produced from deep mines per man employed underground per day worked, 1911–1928, in net tons* [1]

Year	Anthracite [2]	Bituminous	Year	Anthracite [2]	Bituminous
1911	2.75	4.01	1920	2.93	4.80
1912	2.69	4.24	1921	2.70	4.86
1913	2.67	4.16	1922	2.87	4.98
1914	2.67	4.28	1923	2.70	5.15
1915	2.78	4.49	1924	2.53	5.17
1916	2.74	4.57	1925	2.60	5.09
1917	2.89	4.51	1926	2.53	5.07
1918	2.94	4.62	1927	[3] 2.58	5.11
1919	2.81	4.64	1928	2.60	5.26

[1] In making this computation certain estimates had to be made of the division of workers above and below ground and of the production of strip pits in the years 1911 to 1913. The probable error introduced by these estimates is too small to impair the value of the averages.

[2] Beginning with 1923, a small tonnage of culm-bank coal handled through breakers and hitherto counted as fresh-mined coal has been excluded, and the figures are therefore not exactly comparable with earlier years. The difference, however, is small. (See pp. 589 and 590.)

[3] Revised figures.

STRIKES, SUSPENSIONS, AND LOCKOUTS

As shown in Table 40, by far the greater portion of the time lost at the coal mines of the country in 1928 was due to the weak demand. Losses of time due to strikes, suspensions, and lockouts in both the anthracite and bituminous industries amounted to only 4,605,086 man-days as compared with 26,675,109 man-days in 1927.

Most of the time lost because of labor difficulties in the bituminous coal fields is explained by the renewal in 1928 of the suspension that prevailed during the middle of the preceding year. With the expiration on April 1, 1928, of the "truce" agreements made in the preceding autumn, mining activity was curtailed for varying periods in a number of the union districts. That the suspension was centered in the well-known union fields of the central competitive area is shown from the detailed figures, by States, given in Table 41. From September through December, 1928, most of the districts on strike successfully negotiated separate agreements that provided for wage reductions (see pp. 429–431) and that are to run for periods varying from one and one-half to three and one-half years. (Bureau of Labor Statistics: Monthly Labor Review, vol. 28, No. 2, February, 1929, pp. 204–208.)

TABLE 40.—*Men idle in strikes, suspensions, and lockouts and time lost thereby in comparison with time lost for other causes, 1919–1928*

[Includes both anthracite and bituminous coal mines]

Year	Number of men on strike	Average number of days lost		Man-days lost—		
		Per man striking	Per man employed	On account of strikes, suspensions, and lockouts	On account of no market, car shortage, and similar difficulties [1]	Total
1919	453,418	35	20	15,761,410	61,023,906	76,785,316
1920	282,419	21	8	5,914,473	55,732,698	61,647,171
1921	151,263	21	4	3,106,103	108,332,246	111,438,349
1922	603,031	122	87	73,497,043	65,186,691	138,683,734
1923	197,214	20	4	3,868,543	93,359,474	97,228,017
1924	129,452	41	7	5,362,748	84,963,306	90,326,054
1925	186,369	88	22	16,433,036	69,624,737	86,057,773
1926	174,724	38	9	6,707,778	58,424,553	65,132,331
1927	193,322	138	35	26,675,109	55,488,392	82,163,501
1928	86,870	53	7	4,605,086	54,379,657	58,984,743

[1] Computed by the Bureau of Mines from the operators' reports of time worked, on the assumption that the potential working time was 308 days. For 1925 and 1926, however, the potential working time of the anthracite region has been assumed to be 304 days, and for 1927 and 1928, 303.5 days.

TABLE 41.—*Strikes, suspensions, and lockouts in coal mines, by States, in 1928*

State	Total number of of men employed	Number of men on strike	Man-days idle on account of strike	Average number of days lost on account strike	
				Per man employed	Per man on strike
Alabama	25,708				
Arkansas	4,092				
Colorado	12,366	1,594	57,184	5	36
Illinois	64,266	21,815	1,463,409	23	67
Indiana	16,806	3,216	91,842	5	29
Iowa	6,965	1,986	68,623	10	35
Kansas	5,991	1,525	168,766	28	111
Kentucky	62,195	1,130	14,124	(1)	12
Maryland	3,304				
Michigan	1,239	430	6,320	5	15
Missouri	5,964	941	67,585	11	72
Montana	2,191	1,219	9,178	4	8
New Mexico	3,441				
North Dakota	1,335				
Ohio	21,371	9,222	1,576,760	74	171
Oklahoma	6,218				
Pennsylvania, bituminous	133,414	5,999	658,111	5	110
Tennessee	7,849	265	795	(1)	3
Texas	1,462				
Utah	3,352				
Virginia	12,312				
Washington	3,099				
West Virginia	111,733	210	18,650	(1)	89
Wyoming	4,843	1,190	3,057	1	3
Other States	634				
Total bituminous	522,150	50,742	4,204,404	8	83
Pennsylvania anthracite	160,681	36,128	400,682	2	11
Grand total	682,831	86,870	4,605,086	7	53

[1] One-half day or less

METHODS OF MINING AND PREPARATION

REVIEW OF ENGINEERING PROGRESS IN BITUMINOUS INDUSTRY, 1913-1928

The economic difficulties of the bituminous-coal industry in recent years have diverted attention from the brilliant progress it has made in the field of engineering. In comparison even with 1913, business conditions in 1928 were in many respects disappointing. But in comparison with the engineering practice of 1913, practice in 1928 shows an extraordinary and most encouraging improvement. If one considers the advances in mechanization of the mines, in preparation of coal for the market, in coal-storage practice, and above all in efficiency of utilization, it is probably true that never before has the United States made more rapid advance in the wise use of its energy resources. The following review of recent engineering progress in the bituminous-coal industry is adapted from a paper prepared at the request of the World Engineering Congress.[12]

DEVELOPMENTS IN MINING PRACTICE

In the field of coal production the period 1913 to 1928 has seen the beginning of a mechanical revolution underground.

Electrification of mine power.—In the first place the period has witnessed the general electrification of mine power. Electric shovels are fast displacing steam shovels in open-pit mining. Stimulated in part by high wage rates the tonnage of bituminous coal mined by stripping has risen from 1,281,000 in 1914 to 19,789,000 in 1928. (See Table 45.) With more powerful shovels as much as 40 feet of overburden may now be removed to recover a 3-foot seam of bituminous coal. With a crew of 75 men the Colstrip mine in the Montana subbituminous district produced 1,181,000 tons in 1928, an average of 48 tons per man per day.

In the underground mines of all but the older districts hoists and tipples are now generally electrified. In West Virginia, for example, the quantity of coal consumed by the collieries themselves for power and heat is only 0.4 per cent of the production, as nearly every mine of importance uses electric power purchased from central stations. In the Logan field the ratio of colliery fuel to total output is one-tenth of 1 per cent. (See fig. 21.)

Electrification of haulage.—Underground electric locomotives have become the dominant type of haulage equipment. They have virtually eliminated other types of locomotives. According to Coal in 1925, page 441, in 1924 there were 14,280 electric locomotives in use underground as against 85 compressed-air, 132 steam, and 226 gasoline locomotives. The number of rope haulage units reported was 649. Rope haulage is now little used in American mines (aside from hoisting in slopes). Mine mules have been replaced by the faster and more powerful locomotives on the main haulage ways of all but the smallest mines, and even in the work of gathering single cars in rooms mules are rapidly being supplanted by electric gathering locomotives, equipped sometimes with storage batteries but more often with cable reels. The mines equipped with one or more electric locomotives now supply fully 85 per cent of the output, and 33 per cent is produced by mines in which even the gathering is done electrically and no animals whatever are employed.

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[12] Smith, George Otis, and Tryon, F. G., Development of the American Coal Industry, 1913-1928: World Engineering Congress, Tokyo, October, 1929.

Machine cutting.—In the same way electric cutting machines have almost completely displaced air-driven competitors, and undercutting by machine has been extended to 77 per cent of the deep-mined output, as against 51 per cent in 1913. (See fig. 16.) In West Virginia 85 per cent, in Kentucky 93 per cent, and in Ohio 92 per cent of the product, excluding that of strip mines, is now cut by machine. For the deep-mined tonnage as a whole the method of mining in 1928 was as follows: Cut by machine, 76.9 per cent; mined by hand (of which much is longwall or drawing pillars), 14.8 per cent; shot off the solid, 8.1 per cent. The considerable percentage still shot off the solid is largely explained by the inability of the employers and mine workers to agree on a satisfactory differential between the wage rate for pick mining and for machine cutting with hand loading.

Power drilling of shot holes.—With power carried to the working face electric drilling of shot holes becomes feasible and is rapidly being introduced. An obstacle to its more general introduction is the fact that under existing wage scales the price paid miners includes drilling as well as other duties, and it is difficult for the parties to agree on a new price when drilling is to be done by special workmen equipped with portable drills.

Mechanical loading.—The tasks of haulage, of undercutting the coal, and of drilling shot holes are thus already largely mechanized or can readily be so. There remains the heavy labor of shoveling the coal from floor to mine cars. This work, which in the United States involves lifting a mass of 600,000,000 tons an average height of perhaps 3 feet, has hitherto been done entirely by human muscle. Measured in foot-pounds the mechanical work involved reaches astronomical proportions, and the cost of performing it at the former union scale of wages amounts to about $10 a horsepower-hour. Hand shoveling in the mines has thus remained the last stronghold of heavy labor, resisting more than a century the all but universal tendency toward mechanization.

The problem of eliminating hand shovels has been attacked with great energy. Experimental work began during the nineties in the Connellsville and Pocahontas fields and resulted in invention of the O'Toole cutting and loading machine and of the Coloder. The latter was invented by James Elwood Jones. The first modern Coloder was installed in the mines of the Pocahontas Fuel Co. in 1918, but the machine was not placed on the market until 1925. (See L. E. Young, Mining Congress Journal, June, 1929, p. 468.) The first loading machine to attract public notice appeared in 1903. It was the invention of W. A. Hamilton, of Columbus, Ohio. Technically it was a success, but disputes with the miners over the wage rate to be paid showed that the time was not ripe for mechanical loading. In 1909 appeared the Jeffrey entry driver. To Joseph F. Joy the coal-mining industry is largely indebted for the revival of interest in underground loading,[13] and the commercial history of the loading machine may be said to date from 1922, the year when the first Joy 4 B U's were placed on the market, thereby becoming available to operators generally.

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[13] McAuliffe, Eugene, Railway Fuel: New York, 1927, pp. 131-132.

Types of loading machinery.—The number and variety of machines now on the market are nothing short of bewildering. There are machines designed to cut, drill, and load; others to cut and load; and still others to load only. There are machines designed for driving entries and others adapted for work in rooms and machines that move on rails, as well as others with caterpillar tractor mount that crawl anywhere under their own power. Drag-line scrapers have been developed, especially for long-face work. Self-loading conveyors have appeared, ruggedly built and designed to receive the coal as shot down, loading it under their own power. By equipping a shaking conveyor with a "duckbill," it becomes a loading machine, especially adapted to entry or long-face work and used with marked success in Wyoming and elsewhere. For brief descriptions of these varied types the reader is referred to the coal-mine mechanization handbook issued by the American Mining Congress,[14] which also contains a good bibliography.

These machines, where successfully employed, virtually eliminate hand shoveling except for incidental clean-up. Even the duckbill can be used to dispense with 90 per cent of the hand loading. Still other machines, although not abolishing the use of the shovel, greatly reduce the labor. Material savings have been made by portable elevating machines, known as pit-car loaders; with this machine the shoveler need raise the coal only a few inches from the floor to an elevating conveyor, which then hoists it into the mine car. In room-and-pillar mining, as practiced in Illinois, this machine has proved highly successful. Finally there is the hand-loaded face conveyor, first used in the United States in 1902 and in the last four years reintroduced from Europe, where, both on the Continent and in England, it has attained marked success. If it does not eliminate the hand shovel, it at least cuts down the labor by reducing the height to which the miner must lift the coal and facilitates the work of transport. Very clearly the hand-loaded conveyor will be widely used in the United States, especially in thin seams or under otherwise difficult conditions where the use of loading machines proper is impracticable.

Tonnage loaded by machine.—That a revolution in underground practice is under way there can be no doubt, but there is a danger of creating an exaggerated impression as to the degree to which the change has progressed. "Mechanized mining" still applies to only 3 or 4 per cent of the output. In 1928 the quantity loaded by machines that eliminated hand shoveling was 14,559,000 tons. Including mine-car loaders and hand-loaded face conveyors, the total tonnage mechanically mined in 1928 was 21,559,000. (See Tables 47 and 50.)

But the bare figures hardly reveal the intense interest in this subject that has gripped the American bituminous industry. A National Committee on Mechanized Mining, with branches in 21 States and 97 districts, has been created by the American Mining Congress under the chairmanship of L. E. Young. A mechanization survey by the engineer of the congress publishes reports on actual experience of the companies that have installed the new machines. To date, about 60 such reports have been issued.[15] Eager discussion fills the technical journals. Clearly much of this activity is experimental, and some of the machines now on the market will yield to other types. Among the competing types some will emerge as best adapted to particular conditions, for the choice of a particular machine is controlled by conditions in the individual mine. Among the operators who are pioneering in this field, however, one finds the conviction that mechanical loading has come to stay.

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[14] Southward, G. B., Mechanization Engineer; Year Book on Coal-Mine Mechanization: American Mining Congress, Washington, 1928, 273 pp.

[15] Southward, G. B. Work cited. See also current reports in the Mining Congress Journal.

As to the saving in cost, there is a natural feeling that statements on this subject at present would be premature, partly because the machines thus far have been introduced into mines laid out for hand loading, and the possibilities in an entirely new mine designed around the loading machine are not known. Under some conditions savings of 35 cents to 50 cents a ton have been made. But the statistical record leaves small doubt as to the vigor of the movement. The tonnage loaded by machine has increased from 1,879,000 in 1923 to its present level of nearly 15,000,000. In 1926 the output per man in machine-loading mines was 1,216 tons, as against 963 tons for the hand-loading mines. In the same year machine-loading mines operated 246 days and the hand-loading 216 days, indicating that machine-loading mines were able to compete effectively with the hand-loading mines. One mine as large as 4,000 tons a day has been completely mechanized, using entry-driving machines and four types of mechanical loaders, some adapted for narrow work and others for rooms. In the State of Wyoming in 1928, 41 per cent of the tonnage was machine loaded.

Problems raised by mechanical loading.—As may be anticipated, the machine revolution raises a number of problems. First is the task devolving on the management of coordinating the operations of tipple, hoist, haulage system, cutting machines, and loading machines so that the large investment may be continuously employed.[16] A heavy burden is laid on the haulage system to deliver and remove the cars as fast as the machine can load them, for the machine needs a new car at intervals of 3 to 10 minutes, where the hand loader might need one at intervals of 1 to 2 hours. The problem is aggravated by the fact that the machines are installed in mines originally laid out for hand loading. It has been solved in both room-and-pillar and long-face work, but much opportunity for improvement remains, and the future will doubtless see a large increase in the output per machine per shift, which in 1926 averaged 134 tons.[17]

Under the old organization of work the individual miner toiled with his companion alone in their room, visited by a foreman not more than once a day and spending a considerable part of the potential 8-hour shift in waiting for mine cars or supplies.[18] As the hand miner was paid by the ton the management was little concerned at the delay, but the success of mechanized mining depends on keeping the costly machines working as near continuously as possible and calls for a type of management resembling that of the factory. The problem of supervision is simplified by the fact that the men now work in crews of 10 or 20 instead of in pairs in isolated rooms. Double shifting presents obvious economies but has not yet been generally introduced. The concentration of mining raises new problems and permits new methods in the handling of the pressures of roof and floor. By greatly speeding up the rate of extraction in a given area, roof control is commonly facilitated, and long faces or stepped faces may often be introduced as an improvement over the customary room and pillar. D. Harrington points out, however, that where the roof is heavy sandstone there is often danger of "bumps" when the rate of advance exceeds a certain optimum.

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[16] Thompson, Sanford E., Underground Management in Bituminous Coal Mines: Rept. of U. S. Coal Commission, Pt. III, pp. 1893–1969.

[17] Coal in 1927, p. 382.

[18] Thompson, Sanford E., Work cited, p. 1923.

A problem to be faced in the future is the effect on the productive capacity of an industry already overdeveloped.[19] If all mines seek to mechanize the increased output per worker carries danger of further inflation of capacity, a danger that would be intensified if double shifting is introduced.

Serious problems arise in the field of labor relations, especially in the districts where the miners' union is strong. Opposition to the use of machines springs partly from fear of discharge and partly from the natural wish to share in the savings resulting from the machine by an increase in wage rates. The problem of displacement of hand workers has been solved by one large company, which has announced the policy of introducing machines only as fast as the normal turnover through death, retirement, and resignation reduces its labor force. The company finds that if no new men are hired the natural reduction in force proceeds as rapidly as it is practicable to install the machines. Of its 12 mines, 8 are now wholly or partly mechanized. Not all companies, however, are in a position to adopt this policy. Some others, in Illinois, for example, have permitted the miners to divide up the work on such machines as pit-car loaders, two crews of men using the machine on alternate days. The problem of wage rates has been met for the present by putting the loading-machine crews on a day-wage basis and paying a rate higher than for other underground day labor. Under the present union agreement in Illinois, for example, the standard rate for day workers underground is $6.10; the rate for shovelers on pit-car loaders and conveyors is $8.04 a day; and the rate for operators on the Joy and Goodman loading machines is $10.07.[20]

In the future, when the costs and possibilities of the machines are better known, it will doubtless be possible to put the work on an incentive basis, such, for example, as a basic day wage and a bonus of so much per ton, payable to all members of the loading-machine crew. If the wage is made satisfactory employers report that men are glad to be assigned to the machines. Young men of high-school education who would scorn a shoveling job and would seek their fortunes in the machine shops of the factories are candidates for jobs in driving the loading machines.

Very serious problems arise in the field of mine safety.[21] More intensive supervision and rapidity of extraction are factors making for safety. Roof control is generally facilitated, and the power drilling of shot holes removes the temptation that now faces the individual miner to drill shallow holes at the expense of safety. On the other hand, all machinery introduces hazards of its own. Dangerous laxity in ventilation has been observed. The advantage of a continuous cycle of cutting, drilling, shooting, and loading to keep the machines more fully employed is a constant temptation to neglect established safeguards. The danger of explosion is heightened by the increasing number of electrical devices at the face, the noise of the machines deadens the warning sounds of a roof about to fall, and the concentration of many men in a single place makes any disaster potentially a major one. An explosion or a fall of roof that might formerly have cost the lives of two men working alone in their room now threatens perhaps 20 men crowded into a space not much larger. The accident rate in American mines is needlessly high, and in spite of the continued campaign for prevention the fatality rate per thousand men shows little improvement over 1913 and is still three or four times as high as in Europe. Measured per million tons mined the accident rate shows some improvement, falling from 4.89 deaths in 1913 to 3.78 in 1928. This, however, is largely due to the increasing tonnage per man per day. A better measure is the number of deaths per thousand 300-day workers, which was 4.46 in 1912, 4.70 in 1913, 4.50 in 1926, 4.43 in 1927, and 4.64 in 1928. (See Adams, W. W., Coal-Mine Fatalities in the United States, 1928: Bull. 319, Bureau of Mines, 1930, 125 pp.) Perhaps the gravest problem of mechanization is the development of safety standards that will permit the economies made possible by the machines without sacrifice of human life. That this can be done is urged by some pioneers in mechanization, who assert that concentrated mining will be a positive influence in the direction of safety.

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[19] Hamilton, W. H., and Wright, Helen, The Case of Bituminous Coal: New York, 1925.

[20] Black Diamond, Sept. 8, 1928, p. 5.

[21] Harrington, D., Hazards in Connection with Bureau of Mines Concentrated Coal Mining: Inf. Cir. 6070, May, 1928, 11 pp.

The problems are well summarized by D. Harrington, chief safety engineer, United States Bureau of Mines, who writes:[22]

> There is every reason for belief that mechanized concentrated methods of mining present numerous advantages and that they will spread fairly rapidly through the coal-producing industry of the United States. There is no question that these methods are now in many instances being used unsafely and unwisely, and there is also no good reason why they can not be made safe. On the contrary, most of them can be and should be made safe, and the sooner the unsafe methods and practices are discarded the fewer disasters there will be.

What mines can be mechanized?—Under some conditions mechanical loading is thus a demonstrated success. How far it can be introduced elsewhere is largely a question of wage levels and natural conditions. High wages put a premium on labor saving, and it is noteworthy that about two-thirds of the tonnage loaded by machine in 1928 came from districts like Indiana, Illinois, and Wyoming, where the miners' union is or has been strong and day wages have ranged from $6 to $8. On the other hand, more than 2,000,000 tons came from the Pocahontas and Virginia districts, where day wages ranged from $3 to $4 or $5.[23] (See figs. 17 and 18.)

Among the natural conditions that affect the use of loading machines the behavior of the roof is of primary importance. Close timbering tends to interfere with the lateral movement of the machines, and a poor roof seems more of a handicap to mechanization than thin or pitching seams. In the Pittsburgh district the roof is a troublesome draw slate, and largely for this reason attempts to use mobile loading machines in this otherwise magnificent seam have thus far met with indifferent success.[24]

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[22] Harrington, D., Work cited, p. 11.

[23] West Virginia Department of Mines Annual Report: 1926, p. 198; 1927, p. 190.

The Pittsburgh operators are at work on the problem, and it is expected that means will be found to mine the product mechanically, perhaps by substituting long faces for room and pillar, perhaps by the use of conveyors and pit-car loaders, where mobile loading machines are proved impracticable. Indeed, there are few bituminous districts in the United States where some form of concentrated mining, utilizing either loading machines, scrapers, or conveyors, does not offer economies over the systems now in use.

In the American anthracite mines, where engineering standards are quite as good as in the bituminous fields, less than 2 per cent of the product is cut by machine, simply because physical conditions make it difficult or unnecessary to cut the other 98 per cent. The same conditions will doubtless retard the use of loading machines. In the American bituminous fields, on the other hand, it appears that a large part of the future output can be worked by machine. Outside of the Rocky Mountains, where much of the coal lies at great depth, some at about 10,000 feet, most of the unmined coal lies relatively near the surface. The 874,000,000,000 tons of bituminous in the Appalachian and eastern interior fields lie within less than 2,000 feet of the surface,[25] and the 1,294,000,000,000 tons of lignite and subbituminous in the northern Great Plains lie largely within 1,000 feet. As mechanical loading is now being done in Utah under cover as thick as 1,500 or 2,000 feet (although in this instance the roof is a massive sandstone), it is evident that much coal can be mined mechanically before greater depths of working force the adoption of other methods.

DEVELOPMENTS IN PREPARATION

Meanwhile great advances are being made in preparation of coal on the surface, complementary to those underground. Mechanical loading raises new problems in preparation. Miners can no longer pick out the refuse at the face; it must be removed at the tipple, and if the coal bed is broken by partings of impurities the volume of material to be handled may exceed the capacity of the existing tipple. By increasing the preparation facilities, however, the increased burden can usually be carried.

Shaker screens, picking tables, and recent developments in mechanical cleaning by both wet and pneumatic methods tend to meet the burden imposed by mechanization underground and at the same time to improve the quality of the product.

Screen sizing.—Shaker screens are already fast displacing bar screens. The great majority of the mines have now installed screens, and 70 per cent of these are equipped with shaker screens. Mines producing coal for metallurgical use only or in districts where there is no demand for house coal have little need for screens, and about one-fifth of the bituminous shipments come from mines without screens. In the newer districts where the demand for prepared sizes is active practically all mines now use shaker screens. In 1927, among the screen-equipped mines 64.3 per cent of the shipments came from mines with shaker screens only, 7.3 per cent from mines with shaker and bar screens, 18.9 per cent from mines with bar screens, and 9.5 per cent from mines with screens of a type unspecified (usually bar screens).[26]

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[24] McCullough, H. F., and Paul, J. W., Mechanical Loading for Coal Mines in the Pittsburgh District: Carnegie Inst. Technol., Bull. 28, pp. 4–5.

[25] Campbell, Marius R., and others, The Coal Fields of the United States: U. S. Geol. Survey Prof. Paper 100–A, p. 11.

Shaker screens and picking tables make possible hand picking of much larger tonnages than could formerly be cared for by the solitary hand picker stationed in the railroad car. They are potentially superior to picking out the refuse underground, and they have the advantages of mass production under adequate supervision, as opposed to the unsupervised labors of individual miners who work in a bad light and have small incentive to keep the product clean. Moreover, the refuse from the picking table, if crushed and cleaned mechanically, may yield a considerable tonnage of marketable coal, which is lost when gobbed underground. More accurate sizing of coal for special purposes is a further advantage of shaker screens.

Washing and pneumatic cleaning.—Parallel with the developments in sizing has come rapid progress in mechanical cleaning of the coal too small to be picked by hand. The art of wet washing, which has lagged in the United States, is now undergoing a revival. (See Table 53 and fig. 19.) The rheolaveur and other processes have been introduced from Europe. Large-scale washeries are being built to handle the coal from many mines. The Champion plant of the Pittsburgh Coal Co., using the rheolaveur process, handles the product of six mines, cleans 5,000,000 tons a year, and loads simultaneously six different sizes of coal on as many railroad tracks.

Meanwhile, entirely new methods of cleaning have been devised employing air pressure rather than water and potentially applicable wherever the coal is dry. The experiments of Sutton, Steele and Steele, begun about 1910, have borne fruit in the processes of the American Coal Cleaning Corporation and stimulated other systems such as the Arms process, the Peale pneumogravity system, and the Heyl & Patterson system. At the end of 1928, 32 dry-cleaning plants were in operation at mines producing 9,000,000 tons a year. The coal cleaned by air in 1928 was 3,786,000 tons; many new plants are being installed and further increases are expected in 1929. (See Table 55 and fig. 20.)

Pneumatic cleaning is an engineering development of great importance. Once more a need created by technical progress in one art has been met by complementary progress in another. Advances in the field of preparation promise to solve the problems raised by mechanical loading underground.

INCREASE IN OUTPUT PER MAN PER DAY

The net results of these changes is seen in the increasing output per worker. In 1913 the production per man per day in bituminous mines was 3.61 short tons. In 1928 it was 4.73 tons, an increase of 1.12 tons in 15 years. In the preceding 15 years the increase had been 0.52 ton.

PROGRESS IN UTILIZATION OF FUEL

No discussion of engineering developments in the coal industry would be complete without a brief statement of the remarkable advances made by consumers in the handling and use of coal.

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[26] Rogers, H. O., and Tryon, F. G., Nation-wide Increase in Use of Screening Equipment: Coal Age, August, 1929, pp. 475–479.

Storage practice.—Coal, of course, was stored before August, 1914. Several million tons were carried in stocks on the docks at the head of Lakes Superior and Michigan to supply the Northwest during the winter season. Retail yards carried customary reserves and individual railroads, steelworks, and public utilities had adopted the practice of storing against emergencies. It required the World War, with its recurring periods of shortage and high prices, to make the practice general. Large consumers equipped themselves with storage facilities, problems of spontaneous combustion received new attention, and methods of storing even the coals of the Middle West, which had formerly given trouble, were devised. The war-time fuel administrator encouraged storage, and on the day of the armistice the consumers of the country had a total of 63,000,000 tons of bituminous in stock. Stocks were found to have a major influence on the market. The Government instituted quarterly reports on the quantity in storage. So general did the practice become that on April 1, 1927, in anticipation of a prolonged strike, consumers had accumulated the enormous reserve of 75,000,000 tons. (See Table 61 and fig. 8.)

Fuel economy.—Reference has already been made to the remarkable advances in thermal efficiency since 1913 and to their effects on the market. The reduction of 58 per cent in the consumption of coal per kilowatt-hour at central stations has not exhausted the possibilities of economy. The average consumption of all central stations in 1928 was 1.76 pounds of coal per kilowatt-hour. It should, however, be noted that many of the plants use coal of 12,000 B. t. u. or less per pound. (See Table 57.) The best plant, the Columbia station of the Columbia Power Co., on the Ohio River below Cincinnati, has a record of 0.86 pound, or 12,495 B. t. u. per net kilowatt-hour.[27] The best performance is thus barely half of the present average, and great progress may still be made merely by bringing the average closer to what experience has already indicated as possible. In the meantime individual factories have been shutting down their isolated power plants to take advantage of the efficiencies of the central stations. Even where need of processed steam and heat leads the factory to continue to generate its own power great economies have been effected. A leading firm of fuel engineers reports average savings of 17 per cent at factories under its supervision, made possible by the better utilization of existing equipment.[28]

In the same period (1913 to 1928) the unit consumption of locomotive fuel has been reduced 30 per cent. In the freight service the average consumption per thousand gross ton-miles is now 127 pounds (see Table 58), but the best locomotive requires only 70 pounds.[29] Similar economies have been made in the iron and steel industry, where the consumption of fuel per unit of product has fallen 23 per cent since 1913.

Not less important have been the developments in adapting coal to uses hitherto dependent upon oil. The application of pulverized coal to marine boilers, the use of small automatic stokers for house heating, and the brilliant achievements of Bergius, Fischer, Patart, and others in converting coal into oil have largely dispelled the bogey of a world without petroleum. The new processes of producing oil from coal may not perhaps compete with oil from flowing wells, but it seems not too much to hope that if and when a shortage of crude drives prices to much higher levels the world can obtain both its motor fuel and its lubricants from coal.

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[27] Electrical World, Feb. 12, 1927, pp. 341–345.

[28] Gould and Henderson, Even Better Steam Generation: Fuel Engineering Co. of New York, 1927, pp. 4–30.

[29] McAuliffe, Eugene, Railway Fuel, p. 323.

NEED OF FURTHER EFFORT

If the cumulative effect of these advances in underground methods, in preparation, and in utilization is considered, the period since 1913 appears one of notable progress in the energy economy of the country, in spite of the unsatisfactory economic position of the fuel industries. Human labor has been released for potentially higher uses and the life of the world's reserves of fuel increased by centuries. It is well, however, to add a word of caution. In the United States, at least, we are still skimming the cream of our energy resources, and we must not forget that the cream is very thin. As the richer and the more accessible deposits are exhausted mining inevitably suffers from a tendency toward increasing cost,[30] which can only be offset by advances in engineering. The figures of reserves underground must, therefore, be discounted. The American anthracite industry has already entered the stage of increasing difficulty of mining,[31] although it has reserves sufficient for a century or two. The State of Maryland still has 96 per cent of its original coal left, but with the exhaustion of the thicker beds the output per worker is less to-day than it was a generation ago.[32] Although England has used barely 6 per cent of her original reserves, she is reduced to mining seams as thin as 18 inches and thicker beds at depths as great as 3,500 feet.[33]

The lesson of progress is the need for even greater effort. In the United States we still leave 35 per cent of the coal behind in roof, stumps, and pillars, under circumstances that make its ultimate recovery difficult or impossible.[34]

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[30] Hammond, John Hays, and Tryon, F. G., National Supplies of Power: Proc. Internat. Conference on Bituminous Coal, 1926, Carnegie Inst. Technol., pp. 196–199.

[31] Ashmead, D. C., Series of eight articles on The Increasing Difficulties of Mining Anthracite: Coal Age, vol. 23, 1923, pp. 323, 475, 551, 749, 885, 999; vol. 24, 1923, p. 347.

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METHODS OF CUTTING AND SHOOTING

TABLE 42.—*Bituminous coal mined by different methods, by States, in 1928*

State	Mined by hand		Shot off the solid		Cut by machines		From strip pits		Not specified		Total production (net tons)
	Net tons	Per cent	Net tons	Per cent	Net tons	Per cent	Net tons	Per cent	Net tons	Per cent	
Alabama	1,896,767	10.8	4,136,496	23.4	11,241,623	63.8	333,186	1.9	13,290	0.1	17,621,362
Alaska	12,600	10.0	113,500	90.0	------	------	------	------	------	------	126,100
Arizona	550	15.3	3,050	84.7	------	------	------	------	------	------	3,600
Arkansas	9,505	.6	892,383	53.7	645,804	38.9	107,164	6.4	6,117	.4	1,660,973
Colorado	3,604,327	36.6	639,183	6.5	5,498,080	55.8	------	------	106,117	1.1	9,847,707
Georgia	------	------	------	------	------	------	58,390	100.0	------	------	58,390
Illinois	1,477,719	2.6	7,797,104	13.9	42,243,664	75.5	4,339,442	7.8	90,270	.2	55,948,199
Indiana	320,978	2.0	2,709,208	16.5	8,493,023	51.9	4,823,012	29.4	32,359	.2	16,378,580
Iowa	379,742	10.3	2,030,875	55.1	1,199,538	32.6	------	------	73,480	2.0	3,683,635
Kansas	224,308	8.0	1,013,058	36.1	249,242	8.9	1,206,420	42.9	116,696	4.1	2,809,724
Kentucky:											
Eastern	901,374	2.0	2,172,894	4.8	42,498,670	93.2	------	------	10,225	------	45,583,163
Western	66,615	.4	1,121,772	6.9	14,386,410	88.4	701,619	4.3	800	------	16,277,216
Maryland	1,912,108	71.2	118,947	4.4	637,392	23.7	------	------	18,532	.7	2,686,979
Michigan	------	------	9,487	1.5	607,855	98.5	------	------	------	------	617,342
Missouri	338,550	9.1	481,560	12.9	1,073,437	28.8	1,778,507	47.6	60,367	1.6	3,732,421
Montana	29,185	.9	445,974	13.4	1,649,319	49.6	1,181,004	35.5	18,713	.6	3,324,195
New Mexico	1,284,903	47.4	700,723	25.8	725,050	26.7	------	------	1,175	.1	2,711,851
North Carolina	60,860	100.0	------	------	------	------	------	------	------	------	60,860
North Dakota	34,665	2.1	178,145	10.8	636,600	38.6	756,131	45.8	44,389	2.7	1,649,930
Ohio	482,532	3.1	366,018	2.3	12,173,384	77.8	2,373,704	15.2	245,587	1.6	15,641,225
Oklahoma	6,453	.2	735,829	21.0	2,222,723	63.4	516,522	14.8	19,798	.6	3,501,325
Pennsylvania	37,678,569	28.7	3,338,649	2.6	88,950,194	67.8	1,076,871	.8	157,880	.1	131,202,163
South Dakota	------	------	------	------	------	------	------	------	13,929	100.0	13,929
Tennessee	612,511	10.9	1,607,238	28.7	3,300,632	58.8	85,428	1.5	5,150	.1	5,610,959
Texas	374,630	31.7	457,063	38.7	19,742	1.7	330,599	27.9	------	------	1,182,034
Utah	127,544	2.6	[1] 1,030,692	21.3	3,684,308	76.1	------	------	------	------	4,842,544
Virginia	129,060	1.1	1,560,131	13.1	10,211,742	85.8	------	------	------	------	11,900,933
Washington	1,451,418	57.6	791,381	31.4	275,187	10.9	------	------	1,915	.1	2,519,901
West Virginia	17,345,232	13.1	2,815,584	2.1	112,701,896	84.8	48,809	------	40,638	------	132,952,159
Wyoming	277,901	4.2	1,858,498	28.3	4,361,492	66.4	71,769	1.1	2,023	------	6,571,683
Other States	------	------	23,888	100.0	------	------	------	------	------	------	23,888
	71,040,606	14.2	39,149,330	7.8	369,687,007	73.8	19,788,577	4.0	1,079,450	.2	500,744,970

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[1] Includes 465,582 tons reported by the companies as "pillar coal," the method of mining which, of course, differs materially from solid shooting in rooms or entries. Indeed, most of the coal reported as shot off the solid in Utah is probably "pillar coal."

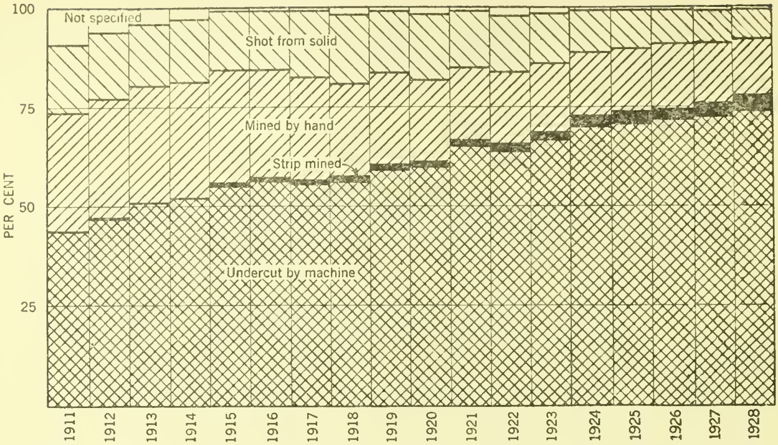

FIGURE 16.—Per cent of total output of bituminous coal mined by different methods, 1911–1928

UNDERCUTTING MACHINES

TABLE 43.—*Number of coal-cutting machines in bituminous coal mines, average output per machine, and per cent of total product cut by machines, by States, 1913, 1923, 1927, and 1928*

State	Number of coal-cutting machines in use				Average output per machine (net tons)				Per cent of total product cut by machines			
	1913	1923	1927	1928	1913	1923	1927	1928	1913	1923	1927	1928
Alabama	377	395	469	445	10, 940	22, 067	25, 555	25, 262	23. 3	42. 6	60. 6	63. 8
Arkansas	27	40	99	94	9, 300	4, 769	5, 576	6, 870	11. 2	14. 6	35. 6	38. 9
Colorado	300	440	397	404	7, 705	11, 129	12, 348	13, 609	25. 0	47. 3	50. 4	55. 8
Illinois	1, 845	3, 151	2, 556	2, 186	17, 686	17, 191	13, 375	19, 325	53. 0	68. 3	73. 0	75. 5
Indiana	732	852	652	512	13, 302	16, 107	13, 644	16, 588	56. 7	54. 3	49. 6	51. 9
Iowa	28	81	93	84	4, 311	14, 584	9, 332	14, 280	1. 6	20. 7	29. 4	32. 6
Kansas	9	22	42	44	2, 458	4, 452	7, 041	5, 665	. 3	2. 2	8. 6	8. 9
Kentucky	1, 263	1, 928	2, 028	1, 969	11, 365	19, 559	30, 675	28, 890	73. 2	84. 2	90. 0	91. 9
Maryland	13	47	42	44	6, 384	12, 398	18, 522	14, 486	1. 7	25. 5	27. 6	23. 7
Michigan	130	80	66	59	6, 636	13, 579	11, 238	10, 303	70. 0	92. 7	98. 0	98. 5
Missouri	104	135	103	101	8, 307	7, 450	6, 282	10, 628	20. 0	29. 6	21. 1	28. 8
Montana	97	95	75	80	11, 099	15, 746	19, 940	20, 616	33. 2	47. 5	47. 6	49. 6
New Mexico	44	107	86	74	11, 297	7, 960	9, 713	9, 798	13. 4	29. 2	28. 5	26. 7
North Carolina	------	1	------	------	------	5, 000	------	------	------	13. 9	------	------
North Dakota	13	25	23	24	17, 094	17, 040	26, 901	26, 525	44. 9	30. 8	40. 5	38. 6
Ohio	1, 681	2, 351	1, 487	906	19, 418	15, 260	8, 217	13, 436	90. 2	88. 5	77. 3	77. 8
Oklahoma	103	183	159	166	6, 511	8, 943	13, 900	13, 390	16. 1	56. 7	57. 9	63. 4
Pennsylvania	6, 301	6, 481	4, 935	4, 293	14, 678	17, 020	17, 706	20, 720	53. 2	64. 1	65. 7	67. 8
Tennessee	252	171	144	146	7, 312	11, 692	21, 855	22, 607	26. 7	33. 1	54. 4	58. 8
Texas	24	5	2	2	4, 204	8, 904	8, 876	9, 871	4. 2	3. 8	1. 3	1. 7
Utah	50	192	142	160	12, 510	16, 778	24, 247	23, 027	19. 2	68. 3	72. 0	76. 1
Virginia	187	277	281	267	22, 497	31, 210	39, 463	38, 246	47. 6	73. 5	85. 9	85. 8
Washington	63	26	14	20	4, 453	9, 726	15, 412	13, 759	7. 2	8. 6	8. 2	10. 9
West Virginia	2, 539	3, 936	3, 297	2, 989	15, 500	21, 592	36, 743	37, 706	55. 3	78. 7	83. 5	84. 8
Wyoming	195	208	196	192	15, 645	18, 237	21, 256	22, 716	41. 3	50. 1	61. 7	66. 4
Other States	2	------	------	------	600	------	------	------	4. 8	------	------	------
	16, 379	21, 229	17, 388	15, 261	14, 801	17, 779	21, 511	24, 224	50. 7	66. 9	72. 2	73. 8

TABLE 44.—*Coal mined by undercutting machines, 1919–1928*

Year	Anthracite				Bituminous coal			
	Machines in use	Quantity mined by undercutting machines (net tons)		Per cent of total fresh-mined product cut by machines	Machines in use	Quantity mined by undercutting machines (net tons)		Per cent of total product cut by machines
		Total	Average per machine			Total	Average per machine	
1919	(1)	1, 575, 205	(1)	1. 9	18, 959	276, 019, 799	14, 559	59. 2
1920	139	938, 073	6, 749	1. 1	19, 103	339, 813, 476	17, 788	59. 8
1921	114	979, 145	8, 589	1. 1	19, 618	272, 702, 389	13, 901	65. 6
1922	82	502, 793	6, 132	1. 0	20, 436	267, 032, 931	13, 067	63. 2
1923	162	1, 208, 542	7, 460	1. 4	21, 229	377, 435, 543	17, 779	66. 9
1924	212	1, 423, 884	6, 716	1. 7	18, 660	336, 271, 335	18, 021	69. 5
1925	159	941, 189	5, 919	1. 6	17, 551	366, 725, 758	20, 895	70. 6
1926	90	931, 650	10, 352	1. 2	17, 466	410, 912, 680	23, 526	71. 7
1927	138	1, 171, 888	8, 492	1. 5	17, 388	374, 040, 637	21, 511	72. 2
1928	193	1, 289, 809	6, 683	1. 8	15, 261	369, 687, 007	24, 224	73. 8

[1] Not available.

STRIPPING OPERATIONS

TABLE 45.—*Coal recovered from strip pits, 1914–1928*

Year	Pennsylvania anthracite				Bituminous coal				Total			
	Number of power shovels in use	Quantity mined by stripping (net tons)		Per cent of fresh-mined total that was stripped	Number of power shovels in use	Quantity mined by stripping (net tons) [1]		Per cent of total that was stripped	Number of power shovels in use	Quantity mined by stripping (net tons)		Per cent of fresh-mined total that was stripped
		Total	Average per shovel			Total	Average per shovel			Total	Average per shovel	
1914	(2)	(2)	(2)	(2)	48	1,280,946	26,686	0.3	(2)	(2)	(2)	(2)
1915	57	1,121,603	19,677	(2)	87	2,831,619	32,547	.6	144	3,953,222	27,453	0.7
1916	105	1,987,800	18,930	1.4	111	3,933,395	35,436	.8	216	5,921,195	27,413	1.0
1917	76	2,301,588	30,284	2.5	182	5,789,977	31,813	1.0	258	8,091,565	31,363	1.2
1918	82	2,360,183	28,783	2.6	276	8,288,245	30,030	1.4	358	10,648,428	29,744	1.6
1919	89	2,006,879	22,549	2.4	287	5,634,951	19,634	1.2	376	7,641,830	20,324	1.4
1920	96	2,054,441	21,400	2.5	312	8,859,553	28,396	1.5	408	10,913,994	26,750	1.7
1921	85	2,027,790	23,856	2.3	279	4,699,511	16,844	1.1	364	6,727,301	18,482	1.3
1922	69	949,745	13,764	1.9	379	9,886,431	26,086	2.3	448	10,836,176	24,188	2.3
1923	95	2,263,098	23,822	2.7	442	11,844,347	26,797	2.1	537	14,107,445	26,271	2.1
1924	95	1,865,677	19,639	2.2	420	13,606,954	32,398	2.8	515	15,472,631	30,044	2.7
1925	97	1,578,478	16,273	2.7	389	16,870,907	43,370	3.2	486	18,449,385	37,962	3.2
1926	99	2,401,356	24,256	3.0	410	16,922,695	41,275	3.0	509	19,324,051	37,965	3.0
1927	112	2,153,156	19,225	2.8	455	18,378,166	40,392	3.6	567	20,531,322	36,210	3.5
1928	108	2,422,924	22,434	3.4	415	19,788,577	47,683	4.0	523	22,211,501	42,469	3.9

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[1] For the years 1915 to 1923, inclusive, the figures of quantity mined by stripping do not include a small amount which was stripped by some other means than steam shovels, so for these years the tonnages are slightly less than the total recovered by stripping shown in some of the tables in earlier reports of this series.

[2] Not available.

TABLE 46.—*Summary of stripping operations that produced bituminous coal in 1928*

[For mines that recover coal both by stripping and by underground operations the returns do not permit separating men engaged in stripping from those engaged in other work. For this reason the figures of men employed represent all persons working at these mines, including those underground. The total tons produced by both methods at these same mines are also shown]

State and county	Number of strip pits	Number of shovels	Coal produced (net tons)		Total value at same mines	Average value per ton	Number of employees				Average number of days worked	Per cent of county or State total that was mined by stripping	Average tons per man per day
							Underground						
			Mined by stripping	Total at same mines			Miners, loaders, and shot firers	All others[1]	Surface	Total			
Alabama: Walker	10	16	333,186	564,157	$1,196,000	$2.12	272	89	320	681	178	[2] 59.1	4.65
Arkansas: Franklin, Johnson, and Sebastian	4	6	107,164	118,141	439,000	3.72	53	14	177	244	90	[2] 90.7	5.40
Georgia: Walker	1	3	58,390	58,390	181,000	3.10			124	124	280	100.0	1.68
Illinois:													
Edgar, Fulton, Jackson, La Salle, Peoria, St. Clair, Saline, and Will	9	35	2,342,183	2,342,183	3,724,000	1.59			617	617	243	100.0	15.63
Livingston	3	1	7,266	7,266	21,000	2.89			18	18	124	100.0	3.25
Perry	3	12	1,035,843	1,035,843	1,743,000	1.68			261	261	224	100.0	17.72
Vermilion	6	10	591,314	591,314	1,057,000	1.79			242	242	225	100.0	10.87
Williamson	9	9	362,836	362,836	567,000	1.56	3		196	199	107	100.0	17.09
State total	[3] 30	67	4,339,442	4,339,442	7,112,000	1.64	3		1,334	1,337	214	7.8	15.16
Indiana:													
Clay	5	14	482,407	482,407	848,000	1.76			335	335	180	100.0	8.01
Greene	6	11	628,430	629,530	895,000	1.42	4	1	225	230	151	99.8	18.10
Pike	6	25	1,679,790	1,679,790	2,614,000	1.56			845	845	139	100.0	14.31
Sullivan, Vermillion, Vigo, and Warrick	9	26	2,032,385	2,032,385	3,169,000	1.56			634	634	202	100.0	15.87
State total	26	76	4,823,012	4,824,112	7,526,000	1.56	4	1	2,039	2,044	167	29.4	14.17
Kansas:													
Bourbon	8	4	27,329	27,329	64,000	2.34			59	59	162	100.0	3.09
Cherokee	14	17	534,428	534,428	1,219,000	2.28			230	230	123	100.0	18.86
Crawford	24	22	644,663	644,663	1,498,000	2.32			480	480	118	100.0	11.36
State total	[3] 46	43	1,206,420	1,206,420	2,781,000	2.31			769	769	122	42.9	12.84
Kentucky: Hopkins and Muhlenberg	9	22	701,619	934,621	1,100,000	1.18	128	45	417	590	184	75.1	8.59

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[1] Includes haulage and track men.

[2] Per cent of county totals, not State.

Includes some pits in which the stripping is done by hand.

TABLE 46.—*Summary of stripping operations that produced bituminous coal in 1928*—Continued

[For mines that recover coal both by stripping and by underground operations the returns do not permit separating men engaged in stripping from those engaged in other work. For this reason the figures of men employed represent all persons working at these mines, including those underground. The total tons produced by both methods at these same mines are also shown]

State and county	Number of strip pits	Number of shovels	Coal produced (net tons)		Total value at same mines	Average value per ton	Number of employees				Average number of days worked	Per cent of county or State total that was mined by stripping	Average tons per man per day
			Mined by stripping	Total at same mines			Underground		Surface	Total			
							Miners, loaders, and shot firers	All others					
Missouri:													
Barton	15	25	1, 261, 184	1, 261, 184	$3, 005, 000	$2. 38			588	588	169	100. 0	12. 73
Bates	4	5	99, 131	99, 131	202, 000	2. 04			94	94	158	100. 0	6. 66
Callaway, Howard, Macon, Monroe, and Randolph	5	3	80, 058	80, 058	182, 000	2. 27			90	90	182	100. 0	4. 89
Henry	3	6	235, 716	235, 716	515, 000	2. 18			114	114	227	100. 0	9. 10
Vernon	5	5	102, 418	102, 418	222, 000	2. 17			125	125	143	100. 0	5. 71
State total	[3] 32	44	1, 778, 507	1, 778, 507	4, 126, 000	2. 32			1, 011	1, 011	172	42. 6	10. 21
Montana: Rosebud	1	3	1, 181, 004	1, 181, 004	1, 772, 000	1. 50			75	75	325	[2] 100. 0	48. 45
North Dakota:													
Bowman, Dunn, McKenzie, Mercer, Stark, and Ward	6	8	390, 116	390, 116	625, 000	1. 60	6		104	110	187	100. 0	18. 96
Burke	3	6	293, 969	293, 969	502, 000	1. 71			82	82	228	100. 0	15. 70
Grant	4	1	7, 409	7, 409	13, 000	1. 75	4		8	12	170	100. 0	3. 63
Hettinger	5		7, 136	7, 136	12, 000	1. 68	8		5	13	162	100. 0	3. 39
McLean	4	3	48, 240	61, 916	124, 000	2. 00	9	6	56	71	151	77. 9	5. 77
Morton	5		5, 110	5, 110	10, 000	1. 96	10		1	11	155	100. 0	3. 01
Oliver	4		4, 151	4, 151	6, 000	1. 45			9	9	164	100. 0	2. 81
State total	31	18	756, 131	769, 807	1, 292, 000	1. 68	37	6	265	308	186	45. 8	13. 42
Ohio:													
Harrison	11	27	1, 408, 679	1, 408, 679	1, 897, 000	1. 35			491	491	217	100. 0	13. 21
Jefferson	5	14	684, 691	686, 486	1, 045, 000	1. 52			263	263	233	99. 7	11. 19
Perry and Stark	4	7	264, 848	264, 848	359, 000	1. 36			110	110	237	100. 0	10. 15
Tuscarawas	4	2	15, 486	32, 226	68, 000	2. 11	7	8	6	21	259	48. 1	5. 93
State total	[3] 24	50	2, 373, 704	2, 392, 239	3, 369, 000	1. 41	7	8	870	885	225	15. 2	11. 99

Oklahoma:												
Haskell, Mayes, Muskogee, Tulsa, and Wagoner	8	13	445, 616	455, 136	1, 209, 000	2. 66	35	1	427	463	185	97. 9	5. 32
Rogers	3	5	70, 906	70, 906	169, 000	2. 38	------	------	106	106	94	100. 0	7. 12
State total	11	18	516, 522	526, 042	1, 378, 000	2. 62	35	1	533	569	168	14. 8	5. 51
Pennsylvania:													
Allegheny	4	9	194, 075	223, 051	350, 000	1. 57	17	5	79	101	240	87. 0	9. 20
Beaver, Cambria, Clearfield, Clinton, Fayette, and Jefferson	7	9	376, 974	1, 128, 373	2, 506, 000	2. 22	189	145	233	567	279	33. 4	7. 14
Washington	4	12	422, 676	575, 205	856, 000	1. 49	70	43	249	362	221	73. 5	7. 18
Westmoreland	5	8	83, 146	363, 193	628, 000	1. 73	157	45	90	292	193	22. 9	6. 43
State total	20	38	1, 076, 871	2, 289, 822	4, 340, 000	1. 90	433	238	651	1, 322	241	. 8	7. 18
Other States [4]	5	11	536, 605	536, 605	484, 000	. 90	------	------	174	174	189	[2] 6. 1	16. 34
Grand total	[3] 250	415	19, 788, 577	21, 519, 309	37, 096, 000	1. 72	972	402	8, 759	10, 133	189	4. 0	11. 27

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[2] Per cent of county totals, not State.

[3] Includes some pits in which the stripping is done by hand.

[4] Tennessee, Texas, West Virginia, and Wyoming.

LOADING MACHINES AND CONVEYORS

Summary.—From approximately 2,000,000 tons in 1923 the production of bituminous coal by mechanized mining has increased to 21,559,000 tons in 1928, a tenfold growth in five years.

In a larger sense the process of mechanization of the mines began when men first put wheels under a "tub," and it is illustrated by such outstanding developments as the cutting machine and the haulage locomotive. The discussion of mechanization now going on in the American coal industry, however, centers around the use of mechanical devices to reduce the labor of hand shoveling into mine cars, and the figures in Tables 47 to 52 are designed to show how far the replacement of hand loading had progressed by the end of 1928.

The figures are based on information courteously furnished by the operators. To make sure that no mine was overlooked all manufacturers of loading machines and conveyors were asked to supply lists of the companies to whom machines had been shipped.

The tonnage of bituminous coal produced by mechanized mining in 1928 is summarized in Table 47. The total of 21,559,000 tons relates only to operations underground. It does not include coal loaded by power shovels in strip pits, which amounted to a further 19,789,000 tons. (See Table 46.) Neither does it include 2,113,000 tons of mechanically mined anthracite, handled largely by scrapers and face conveyors. These figures on anthracite were supplied by the Pennsylvania Department of Mines. This tonnage was produced by means of 293 scraper units, 184 conveyor units, and 13 loading machines. The number of employees engaged in this class of work was 2,967.

It is also important to note that the figures in Table 47 represent production and not capacity. The total is undoubtedly much less than the annual capacity of the machines installed up to the end of 1928, partly because production seldom reaches theoretical capacity but chiefly for other reasons. In the first place, production for the industry as a whole was below the average in 1928; furthermore, many mines in the northern districts where mechanical loading has made the greatest progress were idle during much of 1928 because of uncertainties over the wage scale, uncertainties that were not settled until October or even November; most important of all, many of the machines used in 1928 were installed late in the year and so had little effect on the tonnage for 1928. For these reasons the production by mechanical methods in 1929 will undoubtedly be much higher.

Looking first at the top section of Table 47 one notes that the total loaded by machines was 14,559,000 tons. This includes coal handled by all types of machines that eliminate hand shoveling except for incidental clean-up. By far the largest tonnage was contributed by the mobile loading machines (including entry drivers), which handled 11,811,000 tons during the year. Scrapers accounted for 1,548,000 tons. Self-loading conveyors (including shakers provided with duckbills, conveyors equipped with a cutting device, and certain others designed to receive the coal as shot down) handled 1,200,000 tons.

The middle section of Table 47 deals with conveyors. Including the amount handled by duckbills and other self-loading conveyors the total quantity handled by conveyors was 8,200,000 tons. Hand-loaded conveyors accounted for 2,883,000 tons and pit-car loaders for 4,117,000 tons. Pit-car loaders are often referred to simply as conveyors, but it will prevent confusion to reserve that term for devices that transport the coal for an appreciable distance.

The recapitulation at the foot of Table 47 shows that mobile loading machines accounted for 54.8 per cent of the total produced by mechanized mining. Scrapers contributed 7.2 per cent, pit-car loaders 19.1 per cent, and conveyors (including those equipped with duckbills) 18.9 per cent.

Table 47.—*Tonnage of bituminous coal produced by mechanized mining in 1928*

	Net tons	Per cent
Loaded by machine:		
Mobile loading machines	11, 811, 000	81. 1
Scraper loaders	1, 548, 000	10. 6
Duckbills and other self-loading conveyors	1, 200, 000	8. 3
Total loaded by machine	14, 559, 000	100. 0
Handled by conveyors:		
Duckbills and other self-loading conveyors	1, 200, 000	14. 6
Pit-car loaders	4, 117, 000	50. 2
Other hand-loaded conveyors	2, 883, 000	35. 2
Total handled by conveyors	8, 200, 000	100. 0
Recapitulation, less duplications:		
Mobile loading machines	11, 811, 000	54. 8
Scrapers	1, 548, 000	7. 2
Pit-car loaders	4, 117, 000	19. 1
Conveyors, including duckbills	4, 083, 000	18. 9
Grand total, mechanized mining	21, 559, 000	100. 0

Increase by types of machines, 1926–1928.—In comparison with 1926 the total mechanized tonnage represents an increase of about 100 per cent. Table 48 shows which types of machines have contributed most of this increase. In two years the tonnage handled by mobile loading machines has increased by 4,025,000 tons, or 51.7 per cent. On the other hand, scrapers have barely held their own. The self-loading conveyors have increased 76 per cent, most of which has been contributed by the duckbills. The big surprise has been the growth of pit-car loaders. The amount handled by these humble instruments, whose claim to recognition in the field of mechanized mining was formerly in doubt, has jumped from 523,000 tons in 1926 to 4,117,000 tons in 1928. The increase in tonnage is 3,594,000, and expressed in percentage it reaches fanciful proportions. As for the hand-loaded face conveyor, lack of data for 1926 prevents an exact comparison, but from the information available it is clear that here, too, there has been a very large increase.

Table 48.—*Comparative increase in tonnage handled by the principal types of machines, 1926–1928*

	1926, net tons	1928, net tons	Increase	
			Net tons	Per cent
Mobile loading machines	7, 786, 000	11, 811, 000	+4, 025, 000	+51. 7
Scraper loaders	1, 554, 000	1, 548, 000	−6, 000	−. 4
Duckbills and other self-loading conveyors	682, 000	1, 200, 000	+518, 000	+76. 0
Total loaded by machines	10, 022, 000	14, 559, 000	+4, 537, 000	+45. 3
Pit-car loaders	523, 000	4, 117, 000	+3, 594, 000	+687. 2
Other hand-loaded conveyors	(1)	2, 883, 000	(1)	(1)

[1] Accurate data not available.

Increase in machine loading proper, 1923–1928.—For mechanical loading proper the comparison may be carried back to 1923. The tonnage loaded by mobile machines, scrapers, and duckbills and other self-loading conveyors has been as follows:

	Net tons
1923	1, 880, 000
1924	3, 496, 000
1925	6, 148, 000
1926	10, 022, 000
1928	14, 559, 000

Accurate figures on the use of pit-car loaders and hand-loaded conveyors are not available for 1923, but it seems clear that had they been included the total quantity mechanically mined in 1923 would not have exceeded 2,000,000 tons, or less than one-tenth of the corresponding figure for 1928.

Increase in machine loading, by States.—The great increase in mechanical mining has come chiefly in the Northern and Western States. Table 49 traces the growth in each of the principal States from 1926 to 1928. It covers mechanical loading only, omitting pit-car loaders and hand-loaded conveyors, which are covered by Table 50. As a group, the Northern States show a large increase. For Illinois the increase amounts to 57.7 per cent, for Pennsylvania 75.7 per cent, and for Ohio over 400 per cent. The figures for Indiana as given show an increase of only 1.2 per cent, but if scrapers are excluded and the comparison limited to mobile loading machines Indiana also shows a substantial increase amounting to 17 per cent.

Still more rapid growth is reported from the Rocky Mountain States. In Wyoming the tonnage loaded by machine has increased 106.5 per cent and in Utah 654.8 per cent, while in Montana the entire development of mechanical loading has come about since 1926.

The Southern States as a group show a much slower growth. For Kentucky the percentage of increase is large, but the tonnage handled by machine is still a small part of the State's output. West Virginia shows a slight increase, but Virginia and Alabama report a decrease due largely to the fact that one large operation employing 24 scrapers in 1926 was idle in 1928. In the use of hand-loaded conveyors, however, Alabama shows large gains. (See Table 50.)

TABLE 49.—*Increase in tonnage loaded by machine, 1926–1928*

[Includes mobile loading machines, scrapers, duckbills, and other self-loading conveyors]

State	1926	1928	Increase	
			Net tons	Per cent
Illinois	2, 036, 000	3, 210, 000	+1, 174, 000	+57. 7
Indiana	2, 167, 000	2, 192, 000	+25, 000	[1] +1. 2
Pennsylvania	856, 000	1, 504, 000	+648, 000	+75. 7
Wyoming	1, 142, 000	2, 358, 000	+1, 216, 000	+106. 5
Utah	115, 000	868, 000	+753, 000	+654. 8
Montana		317, 000	+317, 000	
Kentucky	182, 000	473, 000	+291, 000	+159. 9
West Virginia	2, 001, 000	2, 007, 000	+6, 000	+. 3
Virginia and Alabama	1, 198, 000	838, 000	−360, 000	−30. 1
Other States	325, 000	792, 000	+467, 000	+143. 7
	10, 022, 000	14, 559, 000	+4, 537, 000	+45. 3

[1] Excluding scrapers, Indiana shows an increase of 17 per cent.

Distribution of machine-loaded tonnage in 1928.—The progress of machine loading by fields is shown in Figure 17, which represents the tonnage loaded by mobile machines, scrapers, and duckbills in 1928. There are nine areas of conspicuously heavy tonnage. They include southern Wyoming; the Sheridan field of northern Wyoming; Montana; Utah; southern Illinois, including the Belleville district; Indiana; Harrison County, Ohio; parts of Pennsylvania; southern West Virginia (especially the Pocahontas field and its extension into Tazewell County, Va.); and Letcher County, in eastern Kentucky.

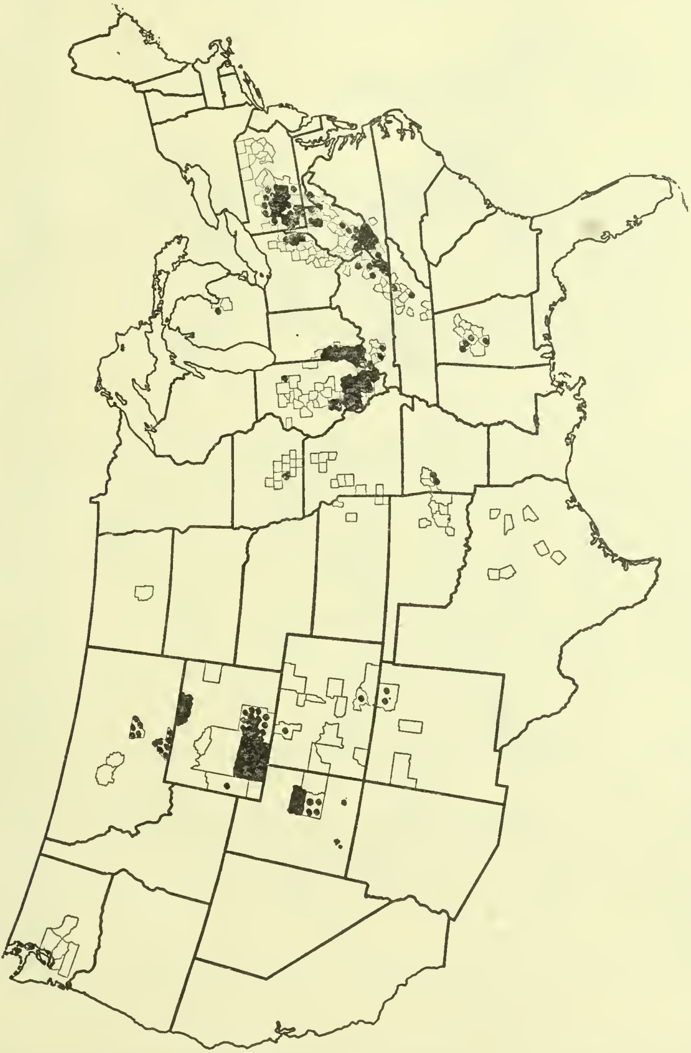

FIGURE 17.—Tonnage of bituminous coal loaded by machines (mobile loading machines, scrapers, and duckbills) in 1928. The map shows in outline all the important coal-producing counties. In any county from which operators reported tonnage loaded by machine there is at least one black dot, no matter how small the quantity. A larger number of dots indicates a larger tonnage, and in some cases the number of dots is so great that the county appears solid black

Distribution of conveyors and pit-car loaders.—The areas in which machine loading proper has thus far made small headway have frequently installed conveyors. (See fig. 18.) Hand-loaded face conveyors have been used successfully in Arkansas, Oklahoma, Missouri, Washington, and notably along the eastern flank of the Appalachians, expecially in Pennsylvania and Alabama. In the Rocky Mountains the conveyor tonnage is contributed chiefly by shakers equipped with duckbills; in Illinois and Indiana it comes almost exclusively from pit-car loaders.

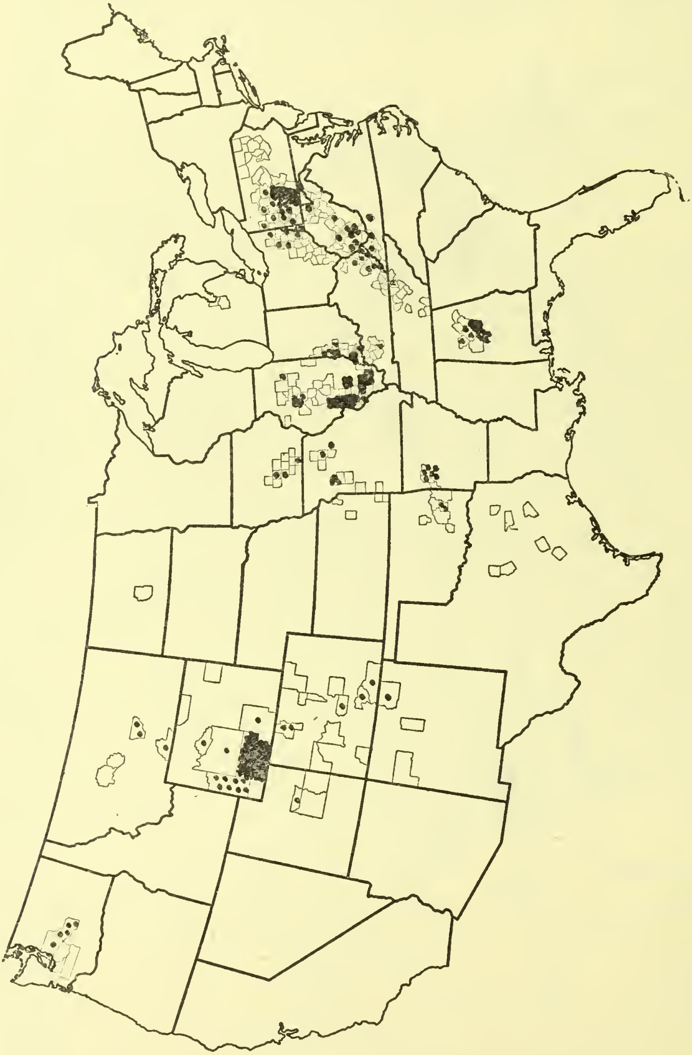

FIGURE 18.—Tonnage of bituminous coal handled by conveyors (shakers equipped with duckbills, hand-loading conveyors, and pit-car loaders) in 1928. The form of presentation is the same as in the preceding diagram. The areas of greatest concentration are in southern Wyoming where the installations are largely shakers equipped with duckbills, in Illinois and Indiana where pit-car loaders are chiefly used, and in central Pennsylvania and Alabama where hand-loading conveyors predominate

Total production with all types of machines, by States.—The tonnage handled by pit-car loaders and hand conveyors is shown for each State in the first column of Table 50. At the head of the column is Illinois, with 3,761,000 tons, of which all but 2,000 tons was mined with pit-car loaders. The other leading States are Pennsylvania (1,178,000 tons) and Alabama (519,000 tons).

The last column of Table 50 gives the total produced with all types of machines. Illinois, with 6,971,000 tons, is also first in total tonnage mechanically mined, followed by Wyoming, Pennsylvania, Indiana, and West Virginia, in the order named.

TABLE 50.—*Total tonnage produced by loading machines, pit-car loaders, and conveyors in 1928, by States*

State	Handled on pit-car loaders and hand-loaded conveyors	Loaded by machine	Total produced by mechanized mining
Illinois	3,761,000	3,210,000	6,971,000
Wyoming	324,000	2,358,000	2,682,000
Pennsylvania	1,178,000	1,504,000	2,682,000
Indiana	234,000	2,192,000	2,426,000
West Virginia	183,000	2,007,000	2,190,000
Utah	10,000	868,000	878,000
Virginia	52,000	743,000	795,000
Alabama	519,000	95,000	614,000
Kentucky	125,000	473,000	598,000
Montana	50,000	317,000	367,000
Other States	564,000	792,000	1,356,000
	7,000,000	14,559,000	21,559,000

Rank of States in per cent of output mechanized.—If the States are ranked according to per cent of their total output produced by mechanized mining, Wyoming leads all others. (See Table 51.) Fully 41.4 per cent of the deep-mined output of the State was mined mechanically, of which 36.4 per cent was loaded by machine and 5 per cent handled by pit-car loaders or hand conveyors. Next in rank came Indiana, with a total of 21.5 per cent mechanically mined, followed by Utah and Montana with about 18 per cent. (It may be noted in passing that if strip mining were included Montana would show nearly two-thirds of the entire output from both deep and strip mines produced without hand shoveling.)

In Illinois 6.1 per cent of the deep-mined output was loaded by machine and 7.2 per cent handled with pit-car loaders, making a total mechanically mined of 13.3 per cent in 1928. In the early months of 1929 this percentage has shown a very large increase.

In the Appalachian fields the percentage mechanically mined was much smaller. In Pennsylvania, for example, it was 2.1 per cent, in West Virginia 1.7 per cent, and in Kentucky 1 per cent.

For the country as a whole the percentage mechanically mined was 4.5.

Number of machines in use.—The total number of machine-loading devices in use in 1928 was 609, divided as follows:

Mobile loading machines	397
Scrapers	130
Duckbills and other self-loading conveyors	82
Total	609

These figures do not include machines used for experimental purposes only or machines in mines that were idle throughout the year, such as, for example, an installation of 24 scrapers already cited.

The total number of pit-car loaders in use during 1928 was 1,040. Conveyors (other than pit-car loaders) were used in 119 mines.

TABLE 51.—*Rank of States in percentage of total deep-mined output produced by mechanized mining in 1928*

State	Percentage loaded by machine	Percentage handled on pit-car loaders and hand-loaded conveyors	Total percentage mined mechanically
Wyoming	36.4	5.0	41.4
Indiana	19.4	2.1	21.5
Montana	15.9	2.5	18.4
Utah	18.0	.2	18.2
Illinois	6.1	7.2	13.3
Virginia	6.0	.4	6.4
Alabama	.6	3.0	3.6
Pennsylvania	1.2	.9	2.1
West Virginia	1.5	.2	1.7
Kentucky	.8	.2	1.0
United States	3.1	1.4	4.5

TABLE 52.—*Mechanical loading underground in bituminous coal mines in 1928*

State	Number of mines				Number of machines					Net tons mechanically mined			Total production of mechanized mines, in net tons			
	Using loading machines only (including scrapers, duckbills, etc.)	Using conveyors only (i. e., pit-car loaders and hand-loaded conveyors)	Using both loading machines and conveyors	Total, less duplications	Mobile loading machines	Scrapers	Duck-bills and other self-loading conveyors	Pit-car loaders	Installations of hand-loaded conveyors [1]	Loaded by machine	Handled by pit-car loaders and hand-loaded conveyors	Total	Mines using loading machines only (including scrapers, duckbills, etc.)	Mines using conveyors only (i. e., pit-car loaders and hand-loaded conveyors)	Mines using both loading machines and conveyors	Total, less duplications
Alabama	4	7	1	11	-------	7	-------	-------	8	94, 958	518, 642	613, 600	(2)	837, 974	(2)	1, 527, 936
Arkansas	1	10	-------	11	-------	(2)	-------	-------	10	(2)	(2)	(2)	(2)	(2)	-------	(2)
Colorado	3	5	2	8	3	-------	(2)	-------	6	4, 987	76, 506	81, 493	(2)	486, 906	(2)	971, 486
Illinois	19	42	10	61	128	-------	(2)	964	-------	3, 209, 636	3, 761, 097	6, 970, 733	2, 594, 532	10, 726, 405	7, 090, 270	20, 411, 207
Indiana	11	6	3	17	72	-------	-------	44	-------	2, 192, 193	233, 985	2, 426, 178	1, 459, 786	753, 783	987, 450	3, 201, 019
Iowa	1	3	-------	4	-------	(2)	-------	(2)	(2)	(2)	16, 884	(2)	(2)	45, 133	-------	(2)
Kentucky	16	6	3	22	19	7	4	-------	8	473, 227	125, 123	598, 350	3, 574, 479	1, 397, 273	819, 083	5, 790, 835
Maryland	-------	2	-------	2	-------	-------	-------	-------	(2)	-------	(2)	(2)	-------	(2)	-------	(2)
Michigan	1	-------	-------	1	-------	(2)	-------	-------	-------	(2)	-------	(2)	(2)	-------	-------	(2)
Missouri	-------	4	-------	4	-------	-------	-------	-------	4	-------	83, 805	83, 805	-------	93, 859	-------	93, 859
Montana	3	3	2	6	13	-------	(2)	11	-------	316, 606	49, 989	366, 595	(2)	1, 022, 492	(2)	1, 631, 696
New Mexico	2	1	-------	3	-------	4	-------	-------	(2)	(2)	(2)	(2)	(2)	(2)	-------	629, 093
Ohio	5	5	-------	10	18	-------	(2)	(2)	3	631, 023	20, 829	651, 852	975, 697	135, 086	-------	1, 110, 783
Oklahoma	-------	1	-------	1	-------	-------	-------	-------	(2)	-------	(2)	(2)	-------	(2)	-------	(2)
Pennsylvania	49	45	7	94	36	74	9	(2)	47	1, 503, 516	1, 178, 399	2, 681, 915	8, 322, 700	6, 491, 968	2, 966, 747	17, 781, 415
Tennessee	4	1	-------	5	-------	6	-------	-------	(2)	50, 307	(2)	(2)	290, 660	(2)	-------	(2)
Utah	9	1	-------	10	17	(2)	4	-------	(2)	867, 756	(2)	877, 756	2, 957, 152	(2)	-------	(2)
Virginia	4	3	-------	7	13	-------	-------	-------	3	742, 724	51, 690	794, 414	2, 239, 916	534, 336	-------	2, 774, 252
Washington	-------	3	-------	3	-------	-------	-------	-------	(2)	-------	(2)	(2)	-------	(2)	-------	(2)
West Virginia	30	14	3	44	44	13	4	4	13	2, 006, 651	183, 502	2, 190, 153	8, 020, 511	3, 171, 604	709, 221	11, 901, 336
Wyoming	14	8	-------	22	34	6	56	10	6	2, 357, 679	324, 769	2, 682, 448	3, 376, 491	1, 213, 232	-------	4, 589, 723
Undistributed	-------	-------	-------	-------	-------	13	5	7	11	107, 452	375, 298	539, 941	1, 332, 498	1, 225, 993	929, 165	4, 367, 762
	176	170	31	346	397	130	82	1, 040	119	14, 558, 715	7, 000, 518	21, 559, 233	35, 144, 422	28, 136, 044	13, 501, 936	76, 782, 402

[1] Number of mines in which hand-loaded conveyors (other than pit-car loaders) were used.

[2] Included under "Undistributed" to avoid disclosing individual operations.

SCREENING AND SIZING

Detailed statistics of sizes of coal shipped from each county were published in Coal in 1927, pages 384 to 394, and a general discussion of the subject appeared in an article by H. O. Rogers and F. G. Tryon, in Coal Age, January, 1929, pages 30 to 32. Statistics on the type of screening equipment used in each field were issued in a second article by the same authors in Coal Age, August, 1929, pages 475 to 478.

CLEANING BY WET AND DRY METHODS

TABLE 53.—*Bituminous coal cleaned at the mines by wet washing methods, 1906–1928*

[Note that pneumatic cleaning operations are not included. See Table 55]

Year	Coal washed (net tons)	Cleaned coal (net tons)	Refuse (net tons)	Per cent of cleaned coal to total output
1906	10, 425, 455	9, 251, 946	1, 173, 509	2. 7
1907	12, 981, 514	11, 269, 518	1, 711, 996	2. 9
1908	13, 660, 478	11, 870, 438	1, 790, 040	3. 6
1909	16, 541, 874	14, 443, 147	2, 098, 727	3. 8
1910	18, 395, 382	16, 035, 387	2, 359, 995	3. 8
1911	(1)	(1)	(1)	(1)
1912	19, 844, 517	17, 538, 572	2, 305, 945	3. 9
1913	25, 051, 801	22, 069, 691	2, 982, 110	4. 6
1914	22, 848, 647	20, 264, 141	2, 584, 506	4. 8
1915	23, 472, 036	20, 873, 727	2, 598, 309	4. 7
1916	25, 632, 974	22, 922, 218	2, 710, 756	4. 6
1917	28, 587, 137	25, 483, 696	3, 103, 441	4. 6
1918	25, 119, 548	22, 017, 293	3, 102, 255	3. 8
1919	19, 187, 837	16, 884, 062	2, 303, 775	3. 6
1920	20, 595, 750	17, 984, 289	2, 611, 461	3. 2
1921	15, 355, 169	13, 628, 724	1, 726, 445	3. 3
1922	(2)	(2)	(2)	(2)
1923	22, 364, 986	20, 140, 385	2, 224, 601	3. 6
1924–1926	(2)	(2)	(2)	(2)
1927	23, 566, 642	21, 119, 441	2, 447, 201	4. 1
1928	23, 508, 269	21, 061, 874	2, 446, 395	4. 2

[1] The returns for 1911 were apparently incomplete, but the error can not now be corrected. As published they showed 12,355,716 tons washed and 10,830,823 tons of cleaned coal, equivalent to 2.7 per cent of the total output.

[2] Canvass not made.

TABLE 54.—*Bituminous coal cleaned at the mines by wet washing methods in 1928, by States* [1]

[Note that pneumatic cleaning operations are not included. See Table 55]

State	Coal washed (net tons)	Cleaned coal (net tons)	Refuse (net tons)	Per cent of cleaned coal to total State output
Alabama	14, 511, 556	13, 064, 095	1, 447, 461	74. 1
Arkansas	7, 581	6, 893	688	. 4
Colorado	439, 401	386, 199	53, 202	3. 9
Illinois	368, 977	315, 017	53, 960	. 6
Indiana	212, 950	193, 784	19, 166	1. 2
Kentucky	597, 503	541, 975	55, 528	. 9
Michigan	129, 330	111, 469	17, 861	18. 1
Montana	111, 800	101, 586	10, 214	3. 1
Pennsylvania	2, 182, 820	2, 033, 908	148, 912	1. 6
Tennessee	362, 665	326, 903	35, 762	5. 8
Virginia	283, 435	229, 271	54, 164	1. 9
Washington	1, 167, 304	892, 498	274, 806	35. 4
West Virginia	3, 132, 947	2, 858, 276	274, 671	2. 1
	23, 508, 269	21, 061, 874	2, 446, 395	4. 2

[1] In addition to the coal washed at the mines, 4,286,479 tons was cleaned by wet methods at washeries in Colorado, Illinois, and Pennsylvania operated by consumers at the point of use.

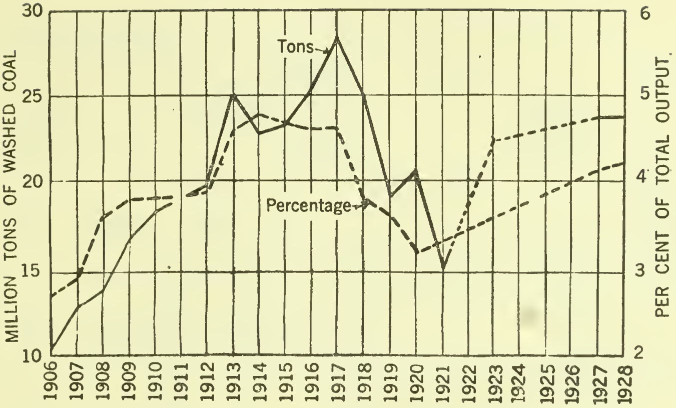

FIGURE 19.—Bituminous coal cleaned at the mines by wet washing methods, 1906–1928. Note that pneumatic cleaning operations at points other than at mines are not included

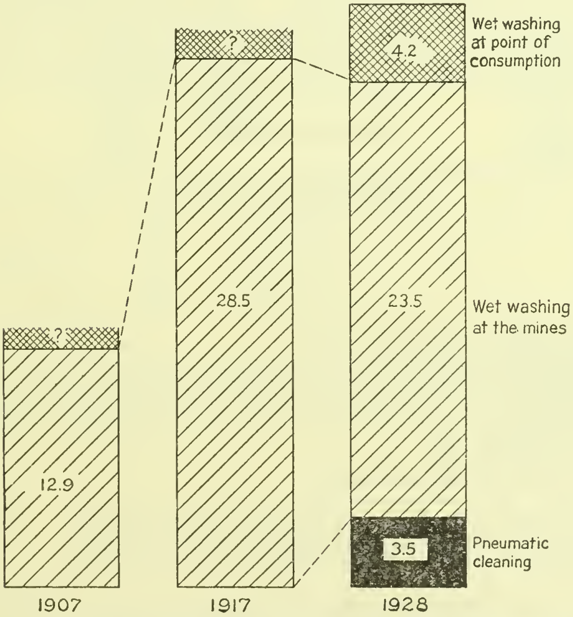

FIGURE 20.—Total tonnage of bituminous coal cleaned by wet washing and by dry mechanical methods, 1907, 1917, and 1928

TABLE 55.—*Bituminous coal cleaned at the mines by pneumatic cleaning methods in 1928* [1]

State	Number of mines equipped with pneumatic cleaning plants	Total production of these mines (net tons)	Cleaned coal obtained from these mines		Per cent of air-cleaned coal to total State output
			Net tons	Per cent of product of these mines	
Pennsylvania	10	3,017,665	1,954,260	64.8	1.5
West Virginia	18	5,782,836	1,740,187	30.1	1.3
Indiana	1	375,058	91,738	24.5	.03
New Mexico	1				
Oklahoma	1				
Virginia	1				
	32	9,175,559	3,786,185	41.3	.7

[1] Coal cleaned in Bradford breakers not included.

CONSUMPTION, STOCKS, AND DISTRIBUTION

CONSUMPTION

Allowing for exports and imports and changes in stocks, the total consumption of bituminous coal in the United States in 1928 was 498,828,000 net tons, and the total consumption of Pennsylvania anthracite was 73,651,000 net tons. The figures are given in Table 3.

A detailed study of the trend of consumption of bituminous coal by uses was given in Coal in 1927, pages 404 to 425. Statistics of consumption by States were printed on pages 426 to 427 of the same report.

FUEL ECONOMY

TABLE 56.—*Indicators of the effect of fuel economy on consumption of coal per unit of performance since the war*

	Pounds	Reduction (per cent)
Steam railroads:		
Pounds per 1,000 gross ton-miles freight service—		
Average, 1919-20	170	
Average, 1928	127	25.3
Pounds per passenger-train car-mile—		
Average, 1919-20	18.5	
Average, 1928	15.0	18.9
Steam electric power plants:		
Pounds per kilowatt-hour, 1919	3.2	
Pounds per kilowatt-hour, 1928	1.76	45.0
Iron and steel—pounds coking coal per ton of pig: [1]		
1918	3,577	
1928	3,053	14.6
Coke manufacture: Savings of heat values through recovery of gas tar, light oils, and breeze by extension of by-product in place of beehive coking, 1913 to 1928, expressed as per cent of coal used for all coke in 1928 [2]		19.2

[1] Includes only savings through higher yields of merchantable coke per ton of coal charged and lower consumption of coke per ton of iron. Excludes economies through recovery of by-products, which are treated in next item.

[2] These by-products are used in part for boiler fuel, in part for metallurgical purposes, in part for domestic heating and cooking, and to a small extent for automotive fuel.

Table 57.—*Fuel consumption by electric public-utility plants in the United States, 1919–1928*

[From reports of division of power resources, United States Geological Survey]

Year	Kilowatt-hours generated (millions)			Per cent of total		Fuel consumed, coal and coal equivalent, net tons	Pounds of fuel consumed by fuel stations	
	By water	By fuel[1]	Total	By water	By fuel		Per kilowatt-hour	Per horsepower-hour
1919	14,606	24,315	38,921	37.5	62.5	38,880,000	3.2	2.4
1920	16,150	27,405	43,555	37.1	62.9	41,420,000	3.0	2.2
1921	14,970	26,005	40,975	36.5	63.5	35,240,000	2.7	2.0
1922	17,207	30,447	47,654	36.1	63.9	38,000,000	2.5	1.9
1923	19,343	36,322	55,665	34.8	65.2	43,522,000	2.4	1.8
1924	19,969	39,044	59,013	33.8	66.2	43,130,000	2.2	1.64
1925	22,356	43,514	65,870	33.9	66.1	44,780,000	2.1	1.57
1926	26,189	47,602	73,791	35.5	64.5	45,856,000	1.95	1.46
1927	29,875	50,330	80,205	37.2	62.8	45,910,000	1.84	1.37
1928	34,696	53,154	87,850	39.5	60.5	46,387,000	1.76	1.31

[1] Includes power generated from wood, which in 1928 amounted to 361,000,000 kilowatt-hours. This is excluded in the calculation of total fuel consumed and average consumption per kilowatt-hour and horsepower-hour given in the last three columns.

Table 58.—*Consumption of coal (or coal equivalent of other fuel) by locomotives in road service on Class I steam railroads, as reported monthly by the Interstate Commerce Commission, 1916–1928*

Year	Pounds of coal per 1,000 gross ton-miles, including locomotive and tender	Pounds of coal per passenger-train car-mile	Year	Pounds of coal per 1,000 gross ton-miles, including locomotive and tender	Pounds of coal per passenger-train car-mile
1916	[1] 169	[1] 18.5	1923	161	18.1
1917	[1] 176	[1] 19.4	1924	149	17.0
1918	[1] 174	[1] 19.2	1925	140	16.1
1919	[1] 164	[1] 18.1	1926	137	15.8
1920	[2] 174	[2] 18.8	1927	131	15.4
1921	162	17.7	1928	127	15.0
1922	163	17.9			

[1] From reports of the fuel conservation section of the United States Railroad Administration, prepared under direction of Eugene McAuliffe. These reports gave the consumption per 1,000 gross ton-miles, excluding locomotive and tender, from which the ratio used above has been estimated.

[2] Estimated from the ratio per 1,000 gross ton-miles, excluding locomotive and tender, which bears a practically constant relation to the other.

TABLE 59.—*Fuel economy as indicated by the coal equivalent of the thermal by-products of coking in by-product ovens, 1913–1928*

By-products included are coke breeze, which is not generally recovered in the manufacture of beehive coke, surplus gas not used in heating ovens, tar, and light oil]

Year	Equivalent coal (net tons)	Per cent which this forms of total coal made into coke	Increase in coal equivalent over 1913	Year	Equivalent coal (net tons)	Per cent which this forms of total coal made into coke	Increase in coal equivalent over 1913
1913	2,600,000	3.8		1921	6,461,000	17.4	+3,861,000
1914	2,461,000	4.8	−139,000	1922	9,058,000	16.7	+6,458,000
1915	3,280,000	5.3	+680,000	1923	12,417,000	14.7	+9,817,000
1916	4,375,000	5.4	+1,775,000	1924	11,628,000	17.9	+9,028,000
1917	5,432,000	6.5	+2,832,000	1925	13,786,000	18.5	+11,186,000
1918	6,785,000	8.0	+4,185,000	1926	15,394,000	18.6	+12,794,000
1919	7,575,000	11.5	+4,975,000	1927	15,642,000	21.0	+13,042,000
1920	9,316,000	12.2	+6,716,000	1928	17,426,000	22.6	+14,826,000

TABLE 60.—*Fuel economy in manufacture of pig iron, 1912–1928*

Year	Pounds coke per gross ton pig iron and ferro-alloys [1]	Yield of coke from coal (per cent)	Pounds coal per gross ton of pig iron and ferro-alloys (column 1 divided by column 2)	Year	Pounds coke per gross ton pig iron and ferro-alloys [1]	Yield of coke from coal (per cent)	Pounds coal per gross ton of pig iron and ferro-alloys (column 1 divided by column 2)
1912	2,436.5	67.1	3,631.1	1921	2,200.6	68.0	3,236.2
1913	2,433.3	66.9	3,637.2	1922	2,176.3	68.3	3,186.4
1914	2,354.4	66.9	3,519.3	1923	2,243.3	67.5	3,323.4
1915	2,252.0	67.2	3,351.2	1924	2,212.0	68.1	3,248.2
1916	2,285.3	66.8	3,421.1	1925	2,150.4	68.8	3,125.6
1917	2,339.7	66.4	3,523.6	1926	2,091.2	68.6	3,048.4
1918	2,375.2	66.4	3,577.1	1927	2,122.3	68.6	3,093.7
1919	2,310.2	67.4	3,427.6	1928	2,088.5	68.4	3,053.4
1920	2,305.6	67.4	3,420.8				

[1] According to annual report, American Iron and Steel Institute. No data were published prior to 1912.

STOCKS OF COAL HELD BY CONSUMERS

Bituminous coal is seldom stored at the mines. The chief element in the reserves aboveground is the quantity held by consumers, which during the dozen years covered by the statistical record has fluctuated between a minimum of 20,000,000 and a maximum of 75,000,000 tons. The trend of stocks in 1928 and its influence upon the market have already been pointed out (p. 427). A statistical summary of the stocks of consumers since October 1, 1916, the date of the earliest survey of stocks, is given in Table 61. (See also fig. 8.) Details by localities appear in the quarterly mimeographed reports on stocks, which may be obtained upon application to the Bureau of Mines.

No record is available in tons of the total stocks of anthracite, but the last column of Table 61 shows the number of days supply in the yards of a representative group of retail dealers.

TABLE 61.—*Stocks of bituminous coal in hands of commercial consumers and stocks of anthracite and bituminous coal in retail dealers' yards, 1916–1928*

[From periodic stock reports of the Bureau of Mines. Coal for steamship fuel, on lake docks, in transit, and in the bins of householders is not included]

Date	Total stock of bituminous coal estimated (tons) [1]	Day's supply at current rate of consumption on date of stock taking								
		By-product coke plants	Steel plants	Other industrials	Coal-gas plants	Electric utilities	Coal dealers, bituminous	Railroads	Total bituminous	Anthracite in retail yards
1916—Oct. 1	27,000,000	(2)	25		(2)	(2)	(2)	20	(3)	(2)
1917—Oct. 1	28,100,000	(2)	27		(2)	(2)	(2)	18	(4)	(2)
1918—July 15	39,700,000	28	27	48	72	39	15	25	31	(2)
Oct. 1	59,000,000	32	45	71	84	47	28	29	43	(2)
Armistice Day (Nov. 11)	63,000,000	35	45	71	85	49	37	31	45	(2)
1919—Jan. 1	57,900,000	32	42	65	81	49	39	32	42	36
Apr. 1	40,400,000	23	35	47	58	48	25	(2)	31	31
1920—Mar. 1	24,000,000	15	9	27	31	21	13	11	18	21
June 1	20,000,000	8	11	24	22	22	10	10	15	15
1921—Jan. 1	45.800,000	29	42	64	55	44	30	23	39	24
Apr. 1	39,500,000	28	38	47	66	48	26	24	36	36
Aug. 1	41,000,000	31	46	56	79	44	42	32	39	50
Nov. 1	48,500,000	38	46	67	87	54	46	31	43	47
1922—Jan. 1	48,000,000	42	48	51	89	51	33	35	41	44
Mar. 1	52,500,000	39	48	56	82	54	23	42	43	28
Apr. 1	[5] 63,000,000	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)
Sept. 1	22,000,000	11	12	32	34	26	11	13	17	5
Oct. 1	26,000,000	14	17	33	38	30	18	15	21	7
Nov. 1	32,000,000	18	21	39	55	32	21	13	23	11
1923—Jan. 1	36,000,000	19	27	40	60	33	18	16	26	11
Feb. 1	38,000,000	20	26	36	62	35	15	18	24	8
Mar. 1	36,000,000	19	26	34	58	34	11	16	22	6
June 1	42,000,000	23	29	39	75	45	27	21	30	19
July 1	46,000,000	26	35	46	89	48	39	28	37	25
Aug. 1	52,000,000	27	35	54	104	52	45	39	44	25
Sept. 1	56,000,000	30	33	56	110	52	38	44	46	21
Oct. 1	60,000,000	33	39	56	91	49	36	41	45	22
1924—Jan. 1	62,000,000	35	43	55	91	51	34	44	46	37
June 1	51,000,000	34	56	53	88	63	40	50	49	49
Sept. 1	47,000,000	30	42	48	90	58	46	42	45	58
1925—Jan. 1	[5] 45,000.000	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)
Mar. 1	44,000,000	25	30	40	78	51	33	35	37	46
June 1	38,000,000	20	27	32	68	48	31	32	32	52
Sept. 1	43,000,000	22	30	30	67	43	27	28	32	53
Nov. 1	48,000,000	26	32	44	78	46	30	30	35	27
1926—Jan. 1	49,000,000	26	28	39	72	48	20	27	30	32
Feb. 1	45,000,000	23	26	37	67	47	17	25	28	18
Apr. 1	40,000,000	21	24	32	60	46	14	23	26	30
May 1	36,000,000	20	25	36	71	54	31	25	31	33
July 1	39,000,000	23	26	35	72	52	43	27	34	40
Aug. 1	41,000,000	24	32	35	61	45	31	30	33	44
Oct. 1	43.000,000	26	37	37	70	45	32	33	35	46
Dec. 31	55,000,000	34	50	41	69	47	23	33	37	54
1927—Apr. 1	75,000,000	38	73	62	77	70	24	59	53	39
July 1	63,400,000	40	59	64	87	76	48	54	54	50
Aug. 1	60,100.000	39	63	63	91	69	41	50	53	57
Oct. 1	61,900,000	40	58	62	93	69	43	48	53	60
Nov. 1	61,300,000	42	50	52	81	61	34	43	46	60
Dec. 31	55,500,000	38	45	44	79	58	27	41	41	57
1928—Feb. 1	51,500,000	29	36	41	81	62	22	38	36	42
Apr. 1	48,300,000	25	35	39	74	60	17	40	34	25
July 1	41,700,000	23	38	37	63	62	43	37	38	55
Oct. 1	41,100,000	27	31	37	72	56	33	29	35	57
Nov. 1	42,400,000	26	34	33	71	51	28	27	30	53
Dec. 31	41,800,000	27	34	33	72	53	26	26	31	54

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[1] The figures for 1918 in this table are based upon an actual count. Beginning with Apr. 1, 1919, the figures are based upon reports from a selected list of 5,000 consumers whose stocks in 1918 bore a known relation to the known total stocks.

[2] No data.

[3] Data incomplete. Estimated as 22 days.

[4] Data incomplete. Estimated as 21 days.

[5] No canvass of consumers was made on this date. The total was estimated from stocks reported in the preceding canvass.

DISTRIBUTION

Special reports on the distribution of coal were published in Mineral Resources for 1917 and 1918. These studies, which traced the movement of coal from each major producing field to each consuming State, have been widely used by the coal trade.[35] They were made possible by financial assistance from the United States Fuel Administration. Lack of funds has since prevented repeating the analysis of distribution in detail, but a current record of certain major movements, such as the lake, tidewater, and New England trades, has been issued in mimeographed form in the weekly coal report. To meet the general demand for distribution of statistics in permanent form, the principal features of the mimeographed series were condensed into summary tables and printed for the first time in Coal in 1926, pages 510 to 519. Certain items on distribution derived from the final annual reports of the coal operators were also included. Comparable figures for 1927 are given in Coal in 1927, pages 430 to 446, and the printed record thus begun is continued in Tables 62 to 75.

MINE FUEL, LOCAL SALES, COAL COKED AT MINES, AND SHIPMENTS

The primary distribution classification is that shown in the basic tables of this report, namely, "used at mines for power and heat," "sold to local trade," "made into coke at mines," and "loaded at mines for shipment." The proportion disposed of under these several classifications varies greatly from district to district, and it also tends to change with the years. (See Table 62.)

TABLE 62.—*Shift in disposal of total output of bituminous coal, 1890–1928*

Year	Per cent of total—				Year	Per cent of total—			
	Loaded at mines for shipment	Made into coke at mines	Sold to local trade	Used at mines for power and heat		Loaded at mines for shipment	Made into coke at mines	Sold to local trade	Used at mines for power and heat
1890	78.5	13.8	6.3	1.4	1920	88.8	5.4	3.7	2.1
1895	78.7	13.6	6.2	1.5	1921	91.8	2.1	3.9	2.2
1900	81.5	13.0	3.7	1.8	1922	90.9	3.1	4.1	1.9
1905	80.9	13.5	3.4	2.2	1923	89.6	4.9	3.9	1.6
1910	82.2	12.5	3.0	2.3	1924	91.3	3.0	4.3	1.4
1915	85.8	9.2	2.8	2.2	1925	91.8	3.0	4.1	1.1
1916	84.3	10.4	3.2	2.1	1926	91.8	3.1	4.1	1.0
1917	85.2	9.1	3.5	2.2	1927	92.7	2.1	4.2	1.0
1918	86.8	7.8	3.2	2.2	1928	93.3	1.4	4.4	.9
1919	87.8	5.9	3.9	2.4					

The proportion of the total output used as fuel by the mines themselves has been declining because of the growing practice of buying power to operate the collieries from central electric stations. As late as 1919 about 2.4 per cent of the bituminous coal production was consumed as colliery fuel. In 1928 the quantity used for heat and power at the mines was 4,602,209 tons, or less than 1 per cent of the total. (See fig. 21.)

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[35] Lesher, C. E., Coal in 1917, Pt. B, Distribution and Consumption: Mineral Resources of the United States, 1917, Pt. II, pp. 1203–1259; Coal in 1918, Pt. B, Distribution and Consumption: Mineral Resources, 1918, Pt. II, pp. 1315–1373. See also an earlier study in Mineral Resources, 1915, Pt. II, pp. 433–513.

The most notable change in disposal of the product has been the decline in the proportion made into coke at the mines. In 1890, before the construction of the first by-product ovens, 13.8 per cent of the production of bituminous coal was charged into coke ovens at the mines. As late as 1916 the proportion was 10.4 per cent, but since the World War it has fallen rapidly and in 1928 amounted to only 1.4 per cent. The change reflects the gradual replacement of beehive with by-product coke.

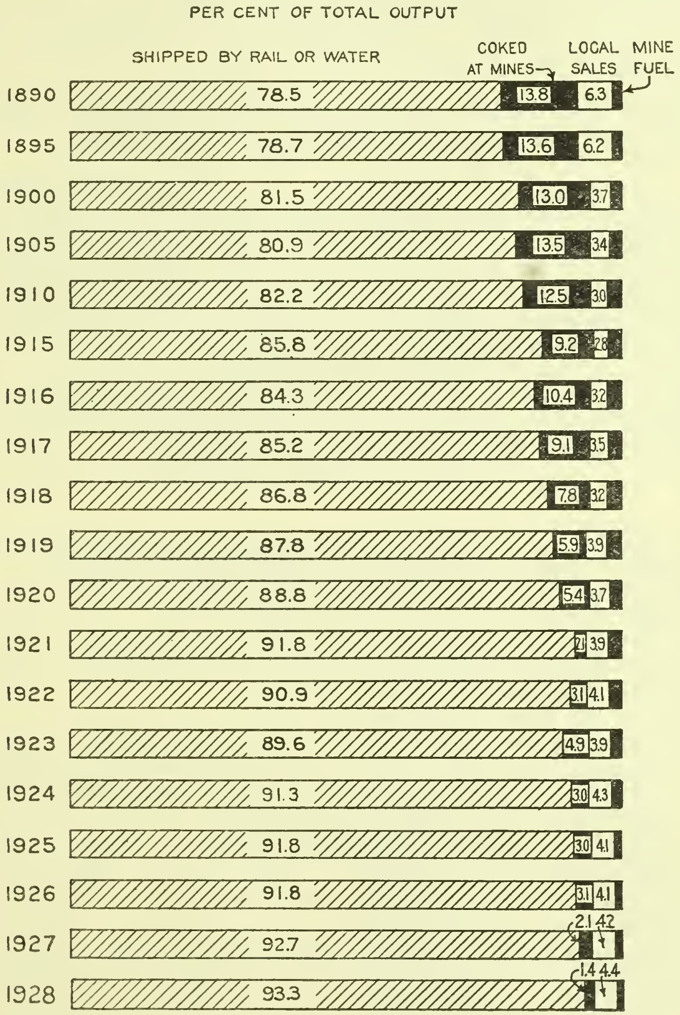

FIGURE 21.—Shift in disposition of total output of bituminous coal, 1890–1928

From 1924 to 1928 the proportion of the output sold locally has been above 4 per cent, a slight increase over the preceding years. In 1928 local sales amounted to 21,989,624 tons, or 4.4 per cent of the total. This quantity includes coal furnished to company employees, often at nominal prices; coal delivered direct to tenders of steam locomotives at the tipple (a very considerable item in some districts); sales by truck and wagon in near-by towns; and sales to industrial plants, such as brick and tile works, adjacent to the mines.

The net result of the several shifts in disposal has been to increase the proportion of the total output loaded at the mines for shipment. From 78.5 per cent of the total in 1890 the shipments have risen to 93.3 per cent in 1928. Corresponding data for anthracite will be found in Table 18A (p. 596).

BITUMINOUS COAL LOADED FOR SHIPMENT BY INDIVIDUAL RAILROADS AND WATERWAYS, AS REPORTED BY OPERATORS

The sum of the coal charged into coke ovens at the mines, the local sales, and the mine fuel in 1928 was 33,397,055 tons out of a total production of 500,744,970 tons. The remainder, 467,347,915 tons, was loaded at the mines for shipment, and of this 21,471,464 tons was loaded into barges and other river vessels and 445,876,451 tons was loaded into railroad cars. Table 64 shows the quantity so originated on each railroad and waterway, as reported by mine operators in answer to the following question:

Railroads or waterways on which product was first loaded for shipment:
Name of road or waterway--
(Give shipments over each road separately) Tons
-- ------
-- ------
-- ------

The information is complete, all operations of which the Bureau of Mines has record as producing in 1928 being accounted for.

As these statistics include nonrevenue railroad fuel, they may differ from those compiled by the railroad companies, which often show only revenue freight and include coal received from connecting lines or coal shipped off the lake docks, as well as that originating at mines on the lines reporting.

Where the road serving the district is a subsidiary of a larger road, some operators may report their coal as loaded on the subsidiary and others as loaded on the parent system. In general, the figures shown here appear under the name reported by the operator, and the bureau does not attempt to combine them by systems, believing that such combinations can best be made by those using the figures, who are usually familiar with coal-traffic problems. To approximate the total for the Southern system, for example, the reader should add to the total shown for the Southern Railway the figures for the Alabama Great Southern; Northern Alabama; Cincinnati, New Orleans & Texas Pacific; and Harriman & Northeastern lines. If such a combination is made, the total will usually be found to check reasonably with the statistics issued by such railroads as keep records of total coal originated.

A few subsidiaries only have been consolidated under the name of the parent road. The shipments over the Coal & Coke Railroad have been included under the Baltimore & Ohio; and those over the Vandalia; the Pittsburgh, Cincinnati, Chicago & St. Louis; the Pennsylvania Co.; the Ohio River & Western; and the Wheeling Terminal have been included under the Pennsylvania system. The

Chicago, Terre Haute & Southeastern, over which operators of Indiana reported as shipping in 1920, was leased in 1921 by the Chicago, Milwaukee, St. Paul & Pacific Railway, and the two are shown combined for 1928 under the name of the latter road.

The figures for the Chicago & Eastern Illinois Railroad include coal loaded in cars of the Elgin, Joliet & Eastern and moved by the latter road over the rails of the Chicago & Eastern Illinois under a trackage agreement.

The Kanawha & Michigan, Toledo & Ohio Central, and Zanesville & Western are shown separately when so reported, rather than in combination with the New York Central, although it is apparent that many operators served by these subsidiaries have reported the name of the parent road.

The quantities shown in the following table, as shipped by waterways, do not all agree with statistics on river traffic published by the United States Engineer Office. In partial explanation, it should be remembered that shipments of coal loaded in cars at the mines and later transferred to boats would be classified by the Bureau of Mines as "rail" and by the Engineer Office as "river." Thus, the considerable tonnage moved down the Ohio from Huntington, W. Va., to Cincinnati by the Island Creek Coal Co., although properly appearing in the Engineer office figures of total traffic on the Ohio, is credited by the Bureau of Mines to the Chesapeake & Ohio Railroad, which hauls coal from the company's mines in Logan County to its pier at Huntington.

TABLE 63.—*Bituminous coal loaded for shipment by individual railroads and waterways, as reported by operators, in 1928, in net tons*

Route	State	Quantity	
		By State	Total for route
RAILROADS			
Alabama Central	Alabama	107,304	107,304
Alabama Great Southern	do	126,447	126,447
Alaska	Alaska	118,440	118,440
Alton & Southern	Illinois	45,004	45,004
Artemus Jellico	Kentucky	108,966	108,966
Atchison, Topeka & Santa Fe	Colorado	843,959	4,052,741
	Illinois	542,669	
	Kansas	495,345	
	Missouri	397,485	
	New Mexico	1,707,348	
	Oklahoma	65,935	
Atlanta, Birmingham & Coast	Alabama	572	572
Baltimore & Ohio	Illinois	830,704	35,831,832
	Indiana	200,357	
	Maryland	29,624	
	Ohio	2,102,714	
	Pennsylvania	10,137,798	
	West Virginia	22,530,635	
Bessemer & Lake Erie	Pennsylvania	2,409,740	2,409,740
Bevier & Southern	Missouri	125,064	125,064
Big Sandy & Cumberland	Kentucky	12,029	12,029
Big Sandy & Kentucky River	do	93,573	93,573
Buffalo & Susquehanna	Pennsylvania	1,040,278	1,040,278
Buffalo Creek & Gauley	West Virginia	741,793	741,793
Buffalo, Rochester & Pittsburgh	Pennsylvania	6,215,209	6,215,209
Cambria & Indiana	do	3,015,166	3,015,166
Campbell's Creek	West Virginia	1,022,206	1,022,206
Carbon County	Utah	442,991	442,991
Caseyville	Illinois	91,928	91,928
Central of Georgia	Alabama	1,063,425	1,119,912
	Georgia	56.487	
Chaffee	Maryland	110,083	110,083

TABLE 63.—*Bituminous coal loaded for shipment by individual railroads and waterways, as reported by operators, in 1928, in net tons*—Continued

Route	State	Quantity	
		By State	Total for route
RAILROADS—continued			
Cheat Haven & Bruceton	West Virginia	24,025	24,025
Chesapeake & Ohio	Kentucky	9,954,723	53,220,081
	West Virginia	43,265,358	
Cheswick & Harmar	Pennsylvania	620,361	620,361
Chicago & Alton	Illinois	1,417,198	1,480,330
	Missouri	63,132	
Chicago & Eastern Illinois	Illinois	1,466,669	3,886,960
	Indiana	2,420,291	
Chicago & Illinois Midland	Illinois	2,672,466	2,672,466
Chicago & North Western	do	3,176,113	3,392,616
	Iowa	136,700	
	Wyoming	79,803	
Chicago, Burlington & Quincy	Colorado	374,228	13,007,850
	Illinois	10,922,778	
	Iowa	235,826	
	Missouri	204,017	
	Wyoming	1,271,001	
Chicago Great Western	Iowa	139,107	139,107
Chicago, Indianapolis & Louisville	Indiana	1,553,974	1,553,974
Chicago, Milwaukee, St. Paul & Pacific	Illinois	24,000	6,621,596
	Indiana	4,791,275	
	Iowa	602,790	
	Missouri	61,364	
	Montana	1,035,184	
	North Dakota	75,013	
	South Dakota	663	
	Washington	31,307	
Chicago, Rock Island & Gulf	Texas	39,487	39,487
Chicago, Rock Island & Pacific	Colorado	2,639	2,240,830
	Illinois	51,446	
	Iowa	1,089,871	
	Missouri	39,580	
	Oklahoma	1,057,294	
Chicago, Springfield & St. Louis	Illinois	564,255	564,255
Cincinnati, Indianapolis & Western	do	7,100	7,100
Cincinnati, New Orleans & Texas Pacific	Kentucky	38,855	71,323
	Tennessee	32,468	
Cleveland, Cincinnati, Chicago & St. Louis	Illinois	4,566,842	5,010,505
	Indiana	443,663	
Clinchfield	Kentucky	59,339	1,818,164
	Virginia	1,758,825	
Colorado & Southeastern	Colorado	431,923	431,923
Colorado & Southern	do	1,870,130	1,870,130
Colorado & Wyoming	do	357,632	357,632
Conemaugh & Black Lick	Pennsylvania	157,857	157,857
Crystal River & San Juan	Colorado	18,270	18,270
Cumberland & Pennsylvania	Maryland	1,322,815	1,322,815
Dardanelle & Russellville	Arkansas	83,247	83,247
Dents Run	Pennsylvania	67,928	67,928
Denver & Intermountain	Colorado	77,495	77,495
Denver & Rio Grande Western	do	2,220,875	4,751,447
	New Mexico	31,003	
	Utah	2,499,569	
Denver & Salt Lake	Colorado	881,360	881,360
Des Moines & Central Iowa	Iowa	181,065	181,065
Detroit, Toledo & Ironton	Ohio	14,834	14,834
East Broad Top Railroad & Coal Co	Pennsylvania	331,360	331,360
Eastern Kentucky	Kentucky	1,151	1,151
Eastern Railway & Lumber Co	Washington	10,132	10,132
East St. Louis & Suburban	Illinois	68,918	68,918
Elgin, Joliet & Eastern	do	1,819,901	1,819,901
Erie	Ohio	17,319	355,843
	Pennsylvania	338,524	
Evansville & Ohio Valley	Indiana	115,445	115,445
Evansville, Indianapolis & Terre Haute	do	2,162,722	2,162,722
Evansville, Suburban & Newburgh	do	162,611	162,611
Fort Smith & Western	Oklahoma	123,845	123,845
Fort Smith, Subiaco & Rock Island	Arkansas	16,453	16,453
Great Northern	Montana	239,163	797,748
	North Dakota	298,885	
	Washington	259,700	
Greenbrier & Eastern	West Virginia	461,928	461,928
Harriman & Northeastern	Tennessee	158,829	158,829
Hocking Valley	Ohio	1,206,351	1,206,351

Table 63.—*Bituminous coal loaded for shipment by individual railroads and waterways, as reported by operators, in 1928, in net tons*—Continued

Route	State	Quantity	
		By State	Total for route
RAILROADS—continued			
Huntingdon & Broad Top Mountain Railroad & Coal Co.	Pennsylvania	535, 340	535, 340
Illinois Central	Alabama	275, 171	19, 559, 760
	Illinois	8, 919, 327	
	Indiana	355, 420	
	Kentucky	10, 009, 842	
Illinois Terminal	Illinois	296, 557	296, 557
Illinois Traction	do	828, 421	828, 421
International & Great Northern	Texas	129, 288	129, 288
Interstate	Kentucky	135, 095	2, 606, 171
	Virginia	2, 471, 076	
Iowa Southern Utilities Co.	Iowa	128, 403	128, 403
Johnstown & Stony Creek	Pennsylvania	20, 379	20, 379
Joplin & Pittsburg	Kansas	326, 230	326, 230
Kanawha & Michigan (see also New York Central)	West Virginia	66, 690	66, 690
Kanawha Central	do	252, 104	252, 104
Kanawha, Glen Jean & Eastern	do	1, 279, 210	1, 279, 210
Kansas City, Clay County & St. Joseph	Missouri	13, 605	13, 605
Kansas City Southern	Arkansas	9, 268	589, 868
	Kansas	223, 199	
	Missouri	265, 756	
	Oklahoma	91, 645	
Kansas, Oklahoma & Gulf	do	176, 338	176, 338
Kelley's Creek & Northwestern	West Virginia	1, 374, 284	1, 374, 284
Kentucky & Tennessee	Kentucky	875, 352	875, 352
Lake Erie, Franklin & Clarion	Pennsylvania	262, 010	262, 010
Laramie, North Park & Western	Colorado	59, 732	59, 732
Ligonier Valley	Pennsylvania	473, 923	473, 923
Litchfield & Madison	Illinois	719, 143	719, 143
Louisville & Nashville	Alabama	3, 889, 453	38, 402, 194
	Illinois	233, 218	
	Kentucky	32, 937, 792	
	Tennessee	925, 841	
	Virginia	415, 890	
Louisville, Henderson & St. Louis	Kentucky	119, 104	119, 104
Marion & Eastern	Illinois	606, 543	606, 543
Michigan Central	Michigan	397, 402	397, 402
Midland Valley	Arkansas	217, 356	613, 363
	Oklahoma	396, 007	
Minneapolis & St. Louis	Illinois	393, 400	531, 203
	Iowa	137, 803	
Minneapolis, St. Paul & Sault Ste. Marie	North Dakota	389, 206	389, 206
Missouri-Illinois	Illinois	421, 908	421, 908
Missouri-Kansas-Texas	Kansas	41, 406	750, 154
	Missouri	118, 396	
	Oklahoma	473, 341	
	Texas	117, 011	
Missouri Pacific	Arkansas	1, 058, 531	6, 938, 484
	Illinois	4, 277, 181	
	Kansas	518, 411	
	Missouri	1, 084, 361	
Mobile & Ohio	Alabama	657, 878	903, 282
	Illinois	245, 404	
Monongahela	Pennsylvania	8, 143, 761	15, 947, 898
	West Virginia	7, 804, 137	
Montana	Arkansas	62, 253	62, 253
Montana, Wyoming & Southern	Montana	410, 737	410, 737
Montour	Pennsylvania	3, 990, 592	3, 990, 592
Nashville, Chattanooga & St. Louis	Tennessee	988, 573	988, 573
New Mexico Midland	New Mexico	39, 028	39, 028
New York Central (includes some coal shipped over subsidiary roads: Kanawha & Michigan, Toledo & Ohio Central, and Zanesville & Western).	Ohio	1, 717, 011	8, 255, 688
	Pennsylvania	4, 311, 992	
	West Virginia	2, 226, 685	
New York, Chicago & St. Louis	Illinois	498, 267	498, 667
	Indiana	400	
Norfolk & Western	Kentucky	5, 120, 885	38, 972, 771
	Virginia	3, 446, 644	
	West Virginia	30, 405, 242	
Norfolk Southern	North Carolina	51, 740	51, 744
Northern Alabama	Alabama	625, 521	625, 520
Northern Ohio Traction & Light Co.	Ohio	9, 641	9, 611

TABLE 63.—*Bituminous coal loaded for shipment by individual railroads and waterways, as reported by operators, in 1928, in net tons*—Continued

Route	State	Quantity	
		By State	Total for route
RAILROADS—continued			
Northern Pacific	Montana	1,484,331	3,454,502
	North Dakota	556,617	
	Washington	1,413,554	
Norton & Northern	Virginia	40,005	40,005
Ohio & Kentucky	Kentucky	52,597	52,597
Ohio River Electric	Ohio	15,236	15,236
Oklahoma City-Ada-Atoka	Oklahoma	114,555	114,555
Oneida & Western	Tennessee	2,491	2,491
Oregon Short Line	Idaho	12,500	1,078,339
	Wyoming	1,065,839	
Oregon-Washington Railroad & Navigation Co	Washington	246,312	246,312
Pacific Coast	do	360,030	360,030
Pennsylvania (includes Pittsburgh, Cincinnati, Chicago & St. Louis)	Illinois	474,604	49,653,501
	Indiana	1,183,366	
	Ohio	3,635,101	
	Pennsylvania	42,282,071	
	West Virginia	2,078,359	
Peoria & Eastern	Illinois	185,434	185,434
Peoria & Pekin Union	do	416,672	416,672
Peoria, Hanna City & Western	do	1,106,934	1,106,934
Pere Marquette	Michigan	169,185	169,185
Peru, La Salle & Deer Park	Illinois	62,245	62,245
Pittsburg & Shawmut	Pennsylvania	2,571,095	2,571,095
Pittsburg County	Oklahoma	5,603	5,603
Pittsburg, Shawmut & Northern	Pennsylvania	729,662	729,662
Pittsburgh & Lake Erie	do	4,489,689	4,489,689
Pittsburgh & Susquehanna	do	172,339	172,339
Pittsburgh & West Virginia (includes West Side Belt)	Ohio	490,175	3,276,763
	Pennsylvania	2,532,925	
	West Virginia	253,663	
Pittsburgh, Chartiers & Youghiogheny	Pennsylvania	414,852	414,852
Pittsburgh, Lisbon & Western	do	115,160	115,160
Preston	West Virginia	209,657	209,657
Puget Sound Electric	Washington	18,886	18,886
Quincy, Omaha & Kansas City	Missouri	7,965	7,965
Reynoldsville & Falls Creek	Pennsylvania	114,622	114,622
Rio Grande & Eagle Pass	Texas	27,050	27,050
Rio Grande Eastern	New Mexico	13,212	13,212
Rio Grande Southern	Colorado	18,983	18,983
Rockdale, Sandow & Southern	Texas	305,586	305,586
Rock Island Southern	Illinois	1,500	1,500
St. Louis & Belleville Electric	do	24,839	24,839
St. Louis & Hannibal	Missouri	11,925	11,925
St. Louis & O'Fallon	Illinois	444,887	444,887
St. Louis & Ohio River	do	148,375	148,375
St. Louis-San Francisco	Alabama	2,489,684	5,064,292
	Arkansas	180,442	
	Kansas	813,958	
	Missouri	741,729	
	Oklahoma	838,479	
St. Louis Southwestern of Texas	Texas	376,392	376,392
San Antonio Southern	do	24,087	24,087
Scott's Run	West Virginia	780,536	780,536
Sewell Valley	do	18,230	18,230
Sloss-Sheffield Steel & Iron Co	Alabama	790,937	790,937
Southern	do	2,724,173	10,879,201
	Illinois	572,768	
	Indiana	2,098,858	
	Kentucky	531,434	
	Tennessee	1,774,024	
	Virginia	3,177,944	
Southern Illinois Railway & Power Co	Illinois	32,799	32,799
Southern Pacific	California	100	827,291
	New Mexico	813,876	
	Oregon	5,635	
	Texas	7,680	
Susquehanna & New York	Pennsylvania	36,307	36,307
Tennessee	Tennessee	597,547	597,547
Tennessee Central	do	799,450	799,450
Tennessee Coal, Iron & Railroad Co	Alabama	2,883,868	2,883,868
Texas & New Orleans	Texas	35,690	35,690
Texas & Pacific	do	46,199	46,199
Texas Short Line	do	32,900	32,900
Thomas & Sayreton	Alabama	380,657	380,657

TABLE 63.—*Bituminous coal loaded for shipment by individual railroads and waterways, as reported by operators, in 1928, in net tons*—Continued

Route	State	Quantity	
		By State	Total for route
RAILROADS—continued			
Toledo & Ohio Central (see also New York Central)	Ohio	201, 282	201, 282
Toledo, Peoria & Western	Illinois	125, 288	125, 288
Toronto, Knoxville & Western	Ohio	168, 327	168, 327
Uintah	Colorado	8, 887	8, 887
Union	Pennsylvania	31, 657	31, 657
Union Pacific	Colorado	1, 455, 427	5, 368, 313
	Kansas	15, 000	
	Utah	50, 228	
	Wyoming	3, 847, 658	
Unity	Pennsylvania	774, 639	774, 639
Ursina & North Fork	do	755	755
Utah	Utah	1, 720, 620	1, 720, 620
Virginian	Virginia	61, 408	10, 050, 120
	West Virginia	9. 988, 712	
Wabash	Illinois	2, 209, 704	2, 469, 513
	Iowa	197, 783	
	Missouri	62, 026	
Washington Run	Pennsylvania	535, 626	535. 626
Western Allegheny	do	369, 016	369, 016
Western Maryland	Maryland	1, 101, 577	4, 345, 889
	Pennsylvania	344, 217	
	West Virginia	2, 900, 095	
West Side Belt	Pennsylvania	(1)	(1)
West Virginia Northern	West Virginia	215, 901	215, 901
Wheeling & Lake Erie	Ohio	3, 076, 539	3, 076, 539
Winifrede	West Virginia	49, 901	49, 901
Woodward Iron Co	Alabama	934, 258	934, 258
Wyoming	Wyoming	629	629
Youngstown & Ohio River	Ohio	23, 715	23, 715
Zanesville & Western (see also New York Central)	do	8, 197	8. 197
Total railroad shipments		445, 876, 451	445, 876, 451
WATERWAYS			
Allegheny River	Pennsylvania	790, 126	790, 126
Black Warrior River	Alabama	47, 590	47, 590
Green River	Kentucky	93, 047	93, 047
Kanawha River	West Virginia	468, 296	468, 296
Monongahela River	Pennsylvania	19, 405, 454	19, 405, 454
Muskingum River	Ohio	100, 000	100, 000
Ohio River	Kentucky	309, 680	565, 709
	Pennsylvania	2, 612	
	West Virginia	253, 417	
Tradewater River	Kentucky	1, 242	1, 242
Total waterway shipments		21, 471. 464	21, 471, 464
Grand total, loaded at mines for shipment by railroads and waterways		467, 347, 915	467, 347, 915
Sold to local trade and used by employees		21, 989, 624	21, 989, 624
Used at mines for power and heat		4, 602, 209	4, 602, 209
Made into coke at mines		6, 805, 222	6, 805. 222
Total production		500, 744, 970	500, 744, 970

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[1] Included under Pittsburgh & West Virginia.

LAKE SHIPMENTS OF BITUMINOUS COAL

For the second consecutive year, a record lake cargo movement took place in 1928. The total quantity loaded into vessels at the Lake Erie ports, according to the Ore and Coal Exchange, was 34,765,743 tons, of which 1,363,622 tons was vessel fuel and 33,402,121 tons was cargo coal. Cargo dumpings exceeded those of 1927 by 550,440 tons and were 3,573,337 tons above the 1923 shipments.

The record lake cargo business in the past two years is partly explained by the labor suspension prevailing in the organized fields north of the Ohio River in both 1927 and 1928. The curtailment of mining in these areas extended from April 1 through the early part of October, 1927. On April 1, 1928, the suspension was renewed in a number of the union districts and continued until the completion of separate district agreements from September to December. Thus, in both 1927 and 1928, some areas of the Middle West and Northwest that ordinarily relied on supplies of all-rail coal from the union fields turned to coal via the Lakes. In addition to the temporary influence of labor difficulties, the lake trade has increased for another reason. Reductions in rail rates, either enforced or voluntary, to lower lake ports have apparently opened new markets to lake coal that were formerly served by all-rail shipments.

TABLE 64.—*Bituminous coal loaded into vessels at Lake Erie ports, 1919–1928, in net tons* [1]

	Cargo coal	Vessel fuel	Total
1919	21,713,341	1,037,051	22,750,392
1920	22,408,355	1,258,783	23,667,138
1921	22,412,380	759,069	23,171,449
1922	18,522,142	829,181	19,351,323
1923	29,828,784	1,628,510	31,457,294
1924	22,974,991	1,347,561	24,322,552
1925	26,330,843	1,532,153	27,862,996
1926	28,159,076	1,584,778	29,743,854
1927	32,851,681	1,450,549	34,302,230
1928:			
January	4,645	3,812	8,457
February	------	------	------
March	73,488	3,082	76,570
April	799,801	29,658	829,459
May	4,185,570	157,328	4,342,898
June	4,509,416	196,266	4,705,682
July	4,983,036	211,530	5,194,566
August	5,460,688	205,663	5,666,351
September	4,485,548	194,171	4,679,719
October	4,456,058	192,496	4,648,554
November	4,113,628	156,300	4,269,928
December [2]	330,243	13,316	343,559
	33,402,121	1,363,622	34,765,743

[1] From records of the Ore and Coal Exchange.

[2] Figures include coal loaded into vessels for winter storage at Lake Erie ports.

Table 65 gives the destination of the cargo shipments of the last three years. Shipments to Canadian and to American ports were 326,665 and 173,712 tons more, respectively, than in the preceding year. A decrease of more than 2,000,000 tons in shipments to American ports on Lake Superior in comparison with 1927 was entirely offset by increases at other American destinations—particularly at Port Huron and Detroit River and at Lake Erie ports.

TABLE 65.—*Destination of bituminous cargo coal dumped into vessels at Lake Erie ports in the seasons of 1926–1928* [1]

Destination	1926		1927		1928	
	Net tons	Per cent	Net tons	Per cent	Net tons	Per cent
American:						
Lake Superior ports	11, 214, 652	39. 9	13, 726, 153	41. 7	11, 433, 282	34. 2
Sault Ste. Marie and river points	642, 823	2. 3	611, 709	1. 8	631, 234	1. 9
Lake Huron ports	425, 675	1. 5	496, 784	1. 5	483, 938	1. 5
Lake Michigan ports	9, 085, 163	32. 3	10, 157, 448	30. 9	10, 561, 364	31. 6
Port Huron and Detroit River	1, 144, 282	4. 1	1, 416, 150	4. 3	2, 530, 183	7. 6
Lake Erie ports	706, 199	2. 5	1, 175, 287	3. 6	2, 117, 322	6. 3
Lake Ontario and St. Lawrence River	13, 267	. 1	2, 195	-------	2, 115	------
Total American	23, 232, 061	82. 7	27, 585, 726	83. 8	27, 759, 438	83. 1
Canadian:						
Lake Superior ports	1, 105, 632	3. 9	1, 461, 135	4. 4	1, 644, 245	4. 9
Sault Ste. Marie and river points	918, 260	3. 3	1, 032, 313	3. 1	1, 126, 226	3. 4
Lake Huron-Georgian Bay ports	903, 368	3. 2	937, 719	2. 9	866, 947	2. 6
Port Huron and Detroit River	701, 420	2. 5	583, 720	1. 8	627, 781	1. 9
Lake Erie ports	638, 233	2. 3	848, 400	2. 6	1, 036, 843	3. 1
Lake Ontario and St. Lawrence River	593, 784	2. 1	452, 728	1. 4	340, 638	1. 0
Total Canadian	4, 860, 697	17. 3	5, 316, 015	16. 2	5, 642, 680	16. 9
Grand total	28, 092, 758	100. 0	32, 901, 741	100. 0	33, 402, 118	100. 0

[1] From records of the Ore and Coal Exchange. As these figures represent movement of vessels away from the ports they do not agree exactly with the total loaded into vessels because at the end of the season some coal is dumped into vessels for storage during the winter and shipment up the Lakes the following year.

The origin by districts of the cargo coal shipped for the years 1919 to 1928 is shown in Table 66, compiled from data furnished by the Ohio Bureau of Coal Statistics. The significant shifts among the principal sources of supply have already been pointed out (p. 431). As the accompanying table is based on railroad records of the coal billed from the mines, the total differs slightly from the total of dumpings at the ports given in Table 64. Corresponding figures for each year from 1910 to 1918 are given in Coal in 1918, Part B, page 1329.

TABLE 66.—*Shipments of bituminous coal to Great Lakes ports for loading into vessels as cargo, by districts of origin, in the seasons of 1919–1928, in net tons* [1]

District	1919	1920	1921	1922	1923
Eastern Kentucky	1, 425, 466	1, 375, 323	2, 624, 194	3, 091, 089	3, 297, 476
Ohio:					
Cambridge	802, 150	778, 776	981, 997	615, 736	954, 867
Hocking	1, 072, 424	2, 575, 086	668, 577	1, 288, 269	919, 927
Northern Ohio	155, 646	453, 829	208, 994	194, 608	361, 567
No. 8	3, 809, 584	3, 799, 023	3, 678, 554	1, 287, 123	3, 716, 307
Pennsylvania:					
Altoona and Meyersdale	10, 227	22, 410	30, 182	81, 420	31, 316
Connellsville	(2)	(2)	(2)	374, 936	468, 859
Northern Pennsylvania	557, 557	1, 044, 579	723, 819	832, 339	1, 081, 927
Pittsburgh	[2] 6, 512, 051	[2] 6, 203, 444	[2] 5, 907, 489	4, 002, 214	7, 977, 903
West Virginia:					
Cumberland-Piedmont	8, 642	21, 459	4, 352	676	796
Fairmont	[3] 828, 383	[3] 1, 284, 041	[3] 1, 014, 514	[3] 1, 369, 969	[3] 3, 169, 505
Kanawha	3, 393, 849	3, 020, 946	3, 687, 136	2, 671, 251	4, 581, 656
Moundsville	(3)	(3)	(3)	(3)	(3)
New River	537, 436	233, 633	208, 890	271, 630	448, 566
Pocahontas	2, 313, 728	1, 434, 183	2, 430, 559	1, 665, 556	2, 445, 507
Thacker-Kenova	314, 026	143, 645	190, 911	761, 962	383, 016
Winding Gulf	------------	------------	------------	------------	------------
Tennessee	13, 109	185	3, 731	25, 667	------------
Virginia	1, 591	92	------------	43, 208	723
	21, 755, 869	22, 390, 654	22, 363, 899	18, 577, 653	29, 839, 918

[1] From records of Ohio Bureau of Coal Statistics.
[2] Figures for Connellsville included with Pittsburgh before 1922.
[3] Figures for Moundsville included with Fairmont before 1925.

TABLE 66.—*Shipments of bituminous coal to Great Lakes ports for loading into vessels as cargo, by districts of origin, in the seasons of 1919–1928, in net tons*—Continued

District	1924	1925	1926	1927	1928
Eastern Kentucky	3, 514, 355	6, 606, 932	6, 933, 527	7, 178, 574	6, 651, 962
Ohio:					
Cambridge	1, 005, 498	4, 381	68, 181	1, 402	------------
Hocking	90, 165	115, 496	173, 953	46, 347	25, 955
Northern Ohio	57, 327	15, 704	29, 724	------------	4, 094
No. 8	2, 851, 212	1, 316, 428	1, 149, 102	298, 355	1, 022, 983
Pennsylvania:					
Altoona and Meyersdale	1, 605	1, 398	1, 875	10, 475	------------
Connellsville	548, 327	367, 418	598, 494	909, 405	1, 395, 445
Northern Pennsylvania	482, 484	5, 096	825, 487	145, 498	941, 320
Pittsburgh	3, 249, 209	2, 106, 587	2, 506, 685	2, 547, 716	4, 293, 906
West Virginia:					
Cumberland-Piedmont	5, 146	4, 023	3, 030	------------	2, 903
Fairmont	[3] 1, 404, 159	1, 623, 499	2, 141, 924	3, 877, 170	2, 705, 011
Kanawha	5, 754, 567	7, 803, 062	7, 548, 932	9, 457, 380	7, 161, 826
Moundsville	(3)	760, 614	326, 877	728, 315	895, 010
New River	353, 049	396, 091	431, 301	712, 747	620, 492
Pocahontas	2, 630, 625	3, 295, 537	3, 404, 807	4, 096, 952	4, 832, 800
Thacker-Kenova	977, 870	1, 794, 479	1, 595, 598	2, 099, 995	1, 827, 921
Winding Gulf	------------	------------	280, 452	599, 870	756, 192
Tennessee	55, 248	17, 562	82, 629	43, 573	42, 074
Virginia	202	98, 877	59, 921	104, 519	143, 830
	22, 981, 048	26, 333, 184	28, 162, 499	32, 858, 293	33, 323, 724

[3] Figures for Moundsville included with Fairmont before 1925.

LAKE SHIPMENTS OF ANTHRACITE

In contrast to the record lake trade in bituminous coal, the 1928 movement of anthracite up the Great Lakes via the ports of Erie and Buffalo was the smallest in recent years. (See Table 67.) Shipments were 1,420,882 net tons as compared with 1,918,389 tons in 1927, 3,512,079 tons in 1923, and more than 4,000,000 tons in each of the years from 1919 to 1921. Figures showing the shipments of anthracite, by months, at Lake Erie ports for each year from 1918 to 1926 are given in Coal in 1926, page 512; comparable figures for 1927 are given in Coal in 1927, page 440.

TABLE 67.—*Anthracite cargo coal loaded into vessels at Lake Erie ports, 1919–1928, in net tons* [1]

	Buffalo	Erie [2]	Total
1919	4, 080, 334	455, 354	4, 535, 688
1920	3, 602, 351	430, 638	4, 032, 989
1921	3, 844, 261	421, 453	4, 265, 714
1922	1, 182, 326	199, 620	1, 381, 946
1923	3, 091, 406	420, 673	3, 512, 079
1924	2, 709, 854	384, 234	3, 094, 088
1925	1, 549, 858	243, 658	1, 793, 516
1926	2, 347, 826	510, 091	2, 857, 917
1927	1, 421, 023	497, 366	1, 918, 389
1928:			
January	------------	------------	------------
February	------------	------------	------------
March	------------	------------	------------
April	13, 553	9, 586	23, 139
May	79, 908	32, 531	112, 439
June	219, 864	114, 083	333, 947
July	209, 956	108, 607	318, 563
August	88, 163	79, 512	167, 675
September	90, 126	61, 318	151, 444
October	95, 595	51, 435	147, 030
November	115, 382	51, 263	166, 645
December	------------	------------	------------
	912, 547	508, 335	1, 420, 882

[1] From records of Ore and Coal Exchange.
[2] Beginning with 1928 the figures for Erie include a certain tonnage handled at Ashtabula.

RECEIPTS AT HEAD OF LAKE SUPERIOR

The quantity of anthracite received at Duluth-Superior Harbor in the season of 1928 was 652,095 net tons. This is about one-half of the tonnage received in 1924 and 1926 and represents a decrease of 329,099 tons from 1927.

Receipts of bituminous coal, which amounted to 9,688,342 tons in 1928, were about the same as in 1926 but showed a decrease of 1,764,102 tons in comparison with 1927. The following table is compiled from the records of the United States Engineer Office at Duluth.

Table 68.—*Receipts of coal at Duluth-Superior Harbor, 1919–1928, in net tons* [1]

	Anthracite	Bituminous	Total
1919	1, 795, 257	7, 079, 840	8, 875, 097
1920	1, 637, 477	7, 393, 219	9, 030, 696
1921	1, 844, 642	8, 320, 207	10, 164, 849
1922	566, 362	5, 138, 934	5, 705, 296
1923	1, 419, 984	11, 268, 337	12, 688, 321
1924	1, 289, 994	7, 730, 878	9, 020, 872
1925	790, 132	8, 882, 569	9, 672, 701
1926	1, 272, 973	9, 168, 656	10, 441, 629
1927	981, 194	11, 452, 444	12, 433, 638
1928:			
April	------------	------------	------------
May	40, 186	1, 432, 531	1, 472, 717
June	111, 996	1, 377, 496	1, 489, 492
July	168, 065	1, 597, 929	1, 765, 994
August	102, 017	1, 856, 976	1, 958, 993
September	80, 197	1, 326, 222	1, 406, 419
October	87, 947	1, 074, 820	1, 162, 767
November	61, 687	943, 229	1, 004, 916
December	------------	79, 139	79, 139
	652, 095	9, 688, 342	10, 340, 437

[1] From records of United States Engineer Office, Duluth, Minn.

TIDEWATER BITUMINOUS COAL SHIPMENTS

The quantity of bituminous coal handled at tidewater piers attained a maximum in 1926—57,574,498 net tons—when the export trade was greatly stimulated by the British strike. In the following year tidewater tonnage declined 34.3 per cent to 37,838,612 tons. In 1928 there was a further decrease. The total dumped at the five ports—New York, Philadelphia, Baltimore, Hampton Roads, and Charleston (S. C.)—was 34,718,382 net tons, or 3,120,230 tons less than in 1927. Most of the decrease in comparison with the latter year is accounted for by reductions of 1,384,361 and 1,127,336 tons destined for New England and for export, respectively.

In addition to the five ports mentioned above, a small business is done at piers at other ports in New England and on the South Atlantic, Gulf, and Pacific coasts; but, as shown by a detailed study made in 1918, the quantity handled at these other ports amounted to only 4.1 per cent of the total. For practical purposes, therefore, dumpings at the five Atlantic ports mentioned may be taken as the tidewater coal trade of the United States.

Table 69 summarizes the tidewater movement by ports and destinations by years for the period from 1921 to 1928. As the figures on exports are based on records kept by the railroads operating the piers they differ slightly from the official statistics of exports as kept by the Customs Service, which represent vessel clearances from the port. The differences, however, are slight, and the export figures reported by the railroads are used here because they are comparable with the dumpings for other destinations given in the table.

TABLE 69.—*Total tidewater shipments of bituminous coal, by years, 1921–1928, in net tons*

	1921	1922	1923	1924	1925	1926	1927	1928
By destinations:								
Coastwise to New England	8,858,631	10,892,460	13,374,320	11,488,230	13,463,462	12,948,939	14,828,981	13,444,620
Exports	9,632,688	1,613,390	5,121,654	4,767,887	5,109,491	21,900,304	3,579,575	2,452,239
Bunker	8,135,342	4,576,039	5,442,123	4,961,330	5,487,857	8,544,538	5,708,661	5,534,147
Inside capes	3,251,114	3,331,706	4,459,659	3,752,868	4,347,956	4,373,071	4,200,804	4,054,816
Other tonnage	7,445,338	8,058,915	9,122,751	8,246,438	8,714,972	9,807,646	9,520,591	9,232,560
	37,323,113	28,472,510	37,520,507	33,216,753	37,123,738	57,574,498	37,838,612	34,718,382
By ports:								
New York	11,911,974	7,439,431	10,799,410	9,004,960	9,230,448	10,336,698	9,031,032	9,216,675
Philadelphia	3,640,987	2,157,224	3,892,868	2,876,760	3,107,925	5,446,962	3,232,355	2,511,125
Baltimore	4,136,368	1,916,763	5,067,979	3,062,834	3,430,054	10,352,835	3,462,980	2,834,732
Hampton Roads	17,241,422	16,627,009	17,384,484	18,094,077	21,113,240	30,716,282	21,791,796	19,968,954
Charleston	392,362	332,083	375,766	178,122	242,071	721,721	320,449	186,896
	37,323,113	28,472,510	37,520,507	33,216,753	37,123,738	57,574,498	37,838,612	34,718,382

Table 70 analyzes the distribution of the tonnage handled at each port in 1928. It indicates that Hampton Roads is the dominant source both of the coastwise movement to New England and of the sea-borne export trade. New York is an important supplier of bunker coal. The item of "inside capes" for the port of Philadelphia refers to coal dumped into barges and moved to points inside the capes of the Delaware. Similarly, the items of "inside capes" at Baltimore and Hampton Roads refer to coal moved by barge or other vessel to points within the capes at the entrance of Chesapeake Bay. The large item, "other tonnage," at New York probably includes some coal later delivered for ships' bunkers at other points in New York Harbor but consists principally of coal consigned to the many large plants equipped to receive coal by water in and around New York and northern New Jersey. At Hampton Roads the item of "other tonnage" includes coal for the Navy and coastwise shipments to points outside New England—among others, to Panama.

TABLE 70.—*Summary of tidewater shipments of bituminous coal, by ports and destinations, in 1928, in net tons*

Destination	New York	Philadelphia	Baltimore	Hampton Roads	Charleston	Total
Coastwise to New England	728,814	534,081	382,761	11,798,964	------------	13,444,620
Exports	1,807	152,475	196,233	2,008,931	92,793	2,452,239
Bunker	2,840,005	236,408	213,457	2,152,846	91,431	5,534,147
Inside capes	------------	1,515,500	2,006,554	530,090	2,672	4,054,816
Other tonnage	5,646,049	72,661	35,727	3,478,123	------------	9,232,560
	9,216,675	2,511,125	2,834,732	19,968,954	186,896	34,718,382

Tables 71 and 72 give details of the tidewater dumpings for each month of 1928. It is of interest that the highest monthly figure for the year, 3,494,822 tons in December, was less than one-half of the maximum record of 6,997,860 tons handled by the piers in the 30 days of November, 1926.

TABLE 71.—*Monthly tidewater shipments of bituminous coal, by destinations, in 1928, in net tons*

Month	New England	Exports	Bunker	Inside capes	Other tonnage	Total
January	1, 067, 217	251, 935	515, 979	344, 314	837, 201	3, 016, 646
February	1, 151, 489	216, 424	464, 230	333, 241	738, 385	2, 903, 769
March	1, 172, 669	169, 624	522, 246	359, 423	715, 760	2, 939, 722
April	1, 072, 951	151, 806	483, 574	286, 305	650, 480	2, 645, 116
May	1, 023, 757	216, 153	468, 513	305, 025	706, 469	2, 719, 917
June	1, 013, 979	165, 160	426, 399	265, 923	685, 063	2, 556, 524
July	973, 036	227, 888	415, 111	308, 233	691, 559	2, 615, 827
August	977, 158	185, 064	421, 569	329, 198	746, 125	2, 659, 114
September	1, 051, 946	196, 636	410, 006	340, 091	758, 759	2, 757, 438
October	1, 277, 139	172, 527	448, 949	404, 173	899, 265	3, 202, 053
November	1, 256, 807	227, 772	463, 257	377, 592	882, 006	3, 207, 434
December	1, 406, 472	271, 250	494, 314	401, 298	921, 488	3, 494, 822
	13, 444, 620	2, 452, 239	5, 534, 147	4, 054, 816	9, 232, 560	34, 718, 382

TABLE 72.—*Monthly tidewater shipments of bituminous coal, by ports, in 1928, in net tons*

Month	New York	Philadelphia	Baltimore	Hampton Roads	Charleston	Total
January	797, 909	255, 144	234, 055	1, 711, 362	18, 176	3, 016, 646
February	750, 739	212, 885	251, 897	1, 669, 473	18, 775	2, 903, 769
March	774, 990	185, 320	268, 285	1, 697, 821	13, 306	2, 939, 722
April	697, 477	174, 264	240, 576	1, 510, 876	21, 923	2, 645, 116
May	709, 815	171, 236	230, 775	1, 587, 761	20, 330	2, 719, 917
June	733, 205	172, 512	226, 276	1, 420, 165	4, 366	2, 556, 524
July	697, 477	182, 639	224, 060	1, 494, 542	17, 109	2, 615, 827
August	734, 702	195, 122	210, 598	1, 514, 761	3, 931	2, 659, 114
September	733, 358	194, 022	196, 803	1, 623, 923	9, 332	2, 757, 438
October	867, 035	278, 197	247, 676	1, 795, 652	13, 493	3, 202, 053
November	851, 572	237, 443	241, 211	1, 852, 272	21, 936	3, 207, 434
December	868, 396	252, 341	259, 520	2, 090, 346	24, 219	3, 494, 822
	9, 216, 675	2, 511, 125	2, 834, 732	19, 968, 954	186, 896	34, 718, 382

NEW ENGLAND MOVEMENT

New England is supplied with coal partly by coastwise shipments from the principal coal ports and partly by all-rail shipments across the Hudson. Coal may also be obtained by sea from other countries, but under ordinary conditions of the market the quantity imported is small. The origin of the coastwise shipments in 1928 is shown in the preceding tables (Nos. 70 and 72), and in the bureau's weekly coal report will be found a current record of the cars of coal, both anthracite and bituminous, forwarded to New England through the rail gateways of Harlem River, Maybrook, Albany, Rotterdam, Mechanicsville, and Rouses Point. Tables 73 and 74 show the quantities actually received in New England, according to records maintained by the Massachusetts Special Commission on the Necessaries of Life.

Table 73 traces the volume of the supplies reaching New England during each month of 1927 and 1928. Total monthly receipts of bituminous coal in 1928 ran behind those in 1927 for the first nine months. From October to December, however, they were ahead of those in the corresponding months of the preceding year.

TABLE 73.—*Receipts of coal in New England, by months, 1927 and 1928, in net tons*[1]

	Anthracite			Bituminous		
	By tidewater	All rail	Total	By tidewater	All rail	Total
1927						
January	129, 839	406, 219	536, 058	1, 464, 580	897, 687	2, 362, 267
February	94, 722	343, 571	438, 293	1, 522, 580	897. 106	2, 419, 686
March	127, 404	316, 571	443, 975	1, 706, 617	914, 817	2, 621, 434
April	210, 314	446, 353	656, 667	1, 320, 780	451, 597	1, 772, 377
May	293, 471	702, 969	996, 440	1, 163, 934	450, 831	1, 614, 765
June	238, 699	689, 927	928, 626	1, 155, 534	508, 812	1, 664, 346
July	174, 188	552, 644	726, 832	1, 178, 569	450, 639	1, 629, 208
August	249, 324	714, 615	963, 939	1, 146, 706	523, 932	1, 670, 638
September	248, 266	635, 253	883, 519	1, 140, 767	537, 846	1, 678, 613
October	222, 255	680, 567	902, 822	1, 150, 302	548, 468	1, 698, 770
November	229, 119	713, 170	942, 289	1, 087, 249	484, 603	1, 571, 852
December	202, 254	522, 868	725, 122	1, 070, 509	565, 566	1, 636, 075
	2, 419, 855	6, 724, 727	9, 144, 582	15, 108, 127	7, 231, 904	22, 340, 031
1928						
January	115, 275	406, 517	521, 792	1, 121, 384	620, 966	1, 742, 350
February	88, 246	421, 149	509, 395	1, 032, 896	587, 881	1, 620, 777
March	73, 658	402, 201	475, 859	1, 234, 791	540, 703	1, 775, 494
April	259, 091	534, 165	793, 256	1, 026, 126	459, 071	1, 485, 197
May	332, 117	723, 304	1, 055, 421	1, 036, 320	465, 083	1, 501, 403
June	183, 717	485, 352	669, 069	1, 058, 813	409, 333	1, 468, 146
July	152, 263	419. 866	572, 129	892, 487	465, 854	1, 358, 341
August	206, 106	622, 821	828, 927	926, 805	480, 629	1, 407, 434
September	196, 581	533, 420	730, 001	970, 872	472, 950	1, 443, 822
October	306, 947	963, 197	1, 270, 144	1, 261, 287	642, 389	1, 903, 676
November	270, 318	811, 074	1, 081, 392	1, 256, 387	621, 134	1, 877, 521
December	257, 698	611, 326	869, 024	1, 360, 278	707, 331	2, 067, 609
	2, 442, 017	6, 934, 392	9, 376, 409	13, 178, 446	6, 473, 324	19, 651, 770

[1] From records of Massachusetts Special Commission on the Necessaries of Life.

The total receipts of anthracite in New England during 1928 were 9,376,000 net tons, of which 2,442,000 tons came by tidewater and 6,934,000 all rail. The total receipts of bituminous coal were 19,652,000 tons, 13,179,000 coming by tide and 6,473,000 all rail. The proportion of anthracite coming by tidewater, which changed relatively little from 1919 to 1926, was noticeably lower in the next two years. (Table 74.) On the other hand, the proportion of bituminous coal coming by tide has shown remarkable increases during the past decade.

TABLE 74.—*Receipts of coal in New England, by years, 1919–1928*[1]

	Anthracite			Bituminous		
	By tidewater	All rail	Total	By tidewater	All rail	Total
Net tons:						
1919	3, 310, 000	7, 268, 000	10, 578, 000	8, 527, 000	9, 655, 000	18, 182, 000
1920	3, 521, 000	7, 734, 000	11, 255, 000	10, 211, 000	12, 223, 000	22, 434, 000
1921	3, 695, 000	7, 679, 000	11, 374, 000	8, 814, 000	8, 374, 000	17, 188, 000
1922	2, 060, 000	4, 411, 000	6, 471, 000	12, 996, 000	5, 812, 000	18, 808, 000
1923	4, 082, 000	8, 103, 000	12, 185, 000	14, 050, 000	9, 634, 000	23, 684, 000
1924	3, 325, 000	7, 286, 000	10, 611, 000	11, 892, 000	6, 985, 000	18, 877, 000
1925	2, 544, 000	5, 736, 000	8, 280, 000	13, 557, 000	7, 756, 000	21, 313, 000
1926	3, 073, 000	7, 535, 000	10, 608, 000	13, 022, 000	8, 045, 000	21, 067, 000
1927	2, 420, 000	6, 725, 000	9, 145, 000	15, 108, 000	7, 232, 000	22, 340, 000
1928	2, 442, 000	6, 934, 000	9, 376, 000	13, 179, 000	6, 473, 000	19, 652, 000
Per cent:						
1919	31. 3	68. 7	100. 0	46. 9	53. 1	100. 0
1920	31. 3	68. 7	100. 0	45. 5	54. 5	100. 0
1921	32. 5	67. 5	100. 0	51. 3	48. 7	100. 0
1922	31. 8	68. 2	100. 0	69. 1	30. 9	100. 0
1923	33. 5	66. 5	100. 0	59. 3	40. 7	100. 0
1924	31. 3	68. 7	100. 0	63. 0	37. 0	100. 0
1925	30. 7	69. 3	100. 0	63. 6	36. 4	100. 0
1926	29. 0	71. 0	100. 0	61. 8	38. 2	100. 0
1927	26. 5	73. 5	100. 0	67. 6	32. 4	100. 0
1928	26. 0	74. 0	100. 0	67. 1	32. 9	100. 0

[1] From records of Massachusetts Special Commission on the Necessaries of Life.

The general interest of the coal trade in the source of New England's supply of bituminous coal has led to many requests for more detailed information on the subject. Table 75 shows by months for 1927 and 1928 the quantity received in New England all rail and the quantity dispatched to New England by coastwise vessels from each of the four coal ports. Corresponding data for 1919 to 1926 are given in Coal in 1926, pages 518–519.

TABLE 75.—*Monthly coastwise shipments of bituminous coal to New England from Hampton Roads, Baltimore, Philadelphia, and New York and monthly receipts of bituminous coal all rail in New England, 1927 and 1928, in net tons*

Year and month	Coastwise shipments to New England [1]					All-rail receipts in New England [2]
	Hampton Roads	Baltimore	Philadelphia	New York	Total, all ports	
1927						
January	1,147,280	96,056	69,036	100,277	1,412,649	897,687
February	1,190,950	86,552	64,244	91,175	1,432,921	897,106
March	1,344,143	112,024	83,045	126,221	1,665,433	914,817
April	1,011,451	50,429	57,098	78,980	1,197,958	451,597
May	1,021,218	58,949	53,780	51,982	1,185,929	450,831
June	983,506	55,919	49,477	66,045	1,154,947	508,812
July	1,042,036	56,364	22,459	53,015	1,173,874	450,639
August	1,031,305	52,325	29,998	60,335	1,173,963	523,932
September	1,040,694	41,603	47,282	62,935	1,192,514	537,846
October	966,412	58,840	47,479	63,606	1,136,337	548,469
November	845,136	49,402	51,032	50,869	996,439	484,603
December	965,440	29,656	51,089	59,832	1,106,017	565,566
	12,589,571	748,119	626,019	865,272	14,828,981	7,231,904
1928						
January	947,480	47,695	25,102	46,940	1,067,217	620,966
February	1,016,599	19,705	50,628	64,557	1,151,489	587,881
March	1,050,609	41,209	29,281	51,570	1,172,669	540,703
April	949,126	36,270	43,215	44,340	1,072,951	459,071
May	912,170	25,570	36,245	49,772	1,023,757	465,083
June	861,087	37,542	47,172	68,178	1,013,979	409,333
July	813,845	29,591	61,198	68,402	973,036	465,854
August	854,360	21,684	49,223	51,891	977,158	480,629
September	916,279	27,025	45,524	63,118	1,051,946	472,950
October	1,116,752	28,267	56,060	76,060	1,277,139	642,389
November	1,106,485	37,122	38,759	74,441	1,256,807	621,134
December	1,254,172	31,081	51,674	69,545	1,406,472	707,331
	11,798,964	382,761	534,081	728,814	13,444,620	6,473,324

[1] Quantity loaded into vessels over tidewater piers as reported by railroads serving the ports indicated. No shipments were reported from Charleston in 1927 or 1928.
[2] From records of Massachusetts Special Commission on the Necessaries of Life.

IMPORTS AND EXPORTS [36]

IMPORTS

The exigencies of supply and trade make the United States both an importer and exporter of coal. Although this country has a large exportable surplus, there are districts in the Northwest that depend upon supplies from Canada. For example, shipments from Canada in 1928 were 462,827 net tons, or 84.7 per cent of the total imports. Of the quantity entering the country from Canada, 307,629 tons went to Montana and Idaho. (See Table 76.)

Many others of the principal coal-producing countries import as well as export coal. This condition in the movement of coal across international boundary lines is inherent in the trade of any commodity of low value per unit of weight, and the distribution of such a commodity in world trade is governed more by the cost of transportation than by tariff regulations.

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[36] The tables of imports and exports have been compiled by J. A. Dorsey, of the Bureau of Mines, from the records of the Bureau of Foreign and Domestic Commerce.

Under normal conditions of trade and production imports into the United States fluctuate but little from month to month or from year to year. During the last five years they have ranged from a minimum of 417,226 tons in 1924 to a maximum of 601,737 tons in 1925. They consist almost entirely of bituminous coal from Vancouver Island and Alberta received in Washington, Montana, and Idaho, of small quantities of coal brought to Pacific ports as ballast in vessels from Australia and Japan, and of irregular small receipts at northeast Atlantic piers.

Imports of bituminous coal in 1928 were 546,526 net tons, which represented a decrease of less than 1 per cent from 1927 and an increase of 13 per cent over 1926. In comparison with 1927, shipments from Canada fell off 7 per cent, while imports from the United Kingdom increased 76 per cent.

Importations of anthracite in 1928 totaled 384,707 net tons, as compared with 119,030 tons in 1927, and with 813,956 tons in 1926, when hard coal imports were stimulated by the long labor suspension in the hard-coal fields. (Table 77.) Approximately 92 per cent of the anthracite imports came from South Wales and Scotland. Also, 96 per cent of the foreign anthracite imported in 1928 entered the New England States—Maine, New Hampshire, Massachusetts, and Rhode Island.

TABLE 76.—*Bituminous coal imported, by countries and districts, 1924–1928, in net tons*

[Compiled from the records of the Bureau of Foreign and Domestic Commerce]

Country and district	1924	1925	1926	1927	1928
COUNTRY OF ORIGIN					
North America:					
Canada	317, 184	527, 759	407, 464	497, 717	462, 827
Mexico	26	150	250	212	320
Newfoundland and Labrador	----------	----------	5	----------	----------
Salvador	----------	----------	1, 120	----------	----------
West Indies—					
British—					
Jamaica	----------	----------	----------	112	----------
Other	----------	----------	----------	168	----------
Cuba	----------	----------	37	----------	----------
South America:					
Brazil	----------	----------	----------	----------	67
Chile	----------	2	----------	----------	----------
Peru	----------	----------	----------	1	----------
Venezuela	----------	----------	1	----------	----------
Europe:					
Belgium	----------	----------	140	280	118
France	348	67	2	----------	----------
Germany	----------	450	632	----------	5, 716
Italy	----------	6	----------	168	----------
Netherlands	----------	2, 473	280	325	280
Poland and Danzig	----------	----------	----------	----------	3, 462
Soviet Russia	----------	----------	----------	----------	1
United Kingdom—					
England	7, 951	40, 228	38, 330	30, 407	53, 418
Scotland	20, 235				
Asia:					
China	146	----------	10	----------	1
Hong Kong	1	----------	----------	----------	----------
Japan	28, 923	17, 190	32, 454	15, 920	17, 115
Kwantung, leased territory	----------	25	----------	----------	----------
Philippine Islands	----------	4	----------	----------	----------

TABLE 76.—*Bituminous coal imported, by countries and districts, 1924–1928, in net tons*—Continued

Country and district	1924	1925	1926	1927	1928
COUNTRY OF ORIGIN—continued					
Africa:					
Algeria and Tunisia	------	------	------	------	791
Canary Islands	------	------	------	56	------
Oceania:					
Australia	39, 923	10, 919	4, 941	4, 477	2, 410
New Zealand	------	2, 464	------	------	------
Other Oceania	2, 489	------	------	------	------
	417, 226	601, 737	485, 666	549, 843	546, 526
DISTRICT OF ENTRY					
Alaska	41, 980	47, 230	30, 581	30, 481	32, 518
Arizona	------	------	26	------	------
Buffalo	------	------	------	113	------
Chicago	------	------	356	------	------
Connecticut	------	48	------	------	------
Dakota	85	11, 524	10, 483	9, 741	11, 212
Duluth-Superior	------	678	473	980	454
Florida	134	90	37	------	------
Galveston	------	------	1, 260	885	896
Hawaii	45, 207	25, 043	37, 104	20, 256	24, 747
Los Angeles	------	29	632	------	------
Maine and New Hampshire	46, 808	19, 304	50, 533	49, 344	56, 477
Maryland	------	------	280	------	3, 462
Massachusetts	------	10, 544	1, 840	34	20, 380
Michigan	112	6	437	47	440
Montana-Idaho	114, 676	343, 813	253, 894	330, 788	307, 629
New Orleans	------	------	------	336	------
New York	4, 561	10, 518	230	4, 502	4, 948
Oregon	3, 651	3, 295	10	235	403
Philadelphia	------	2, 271	675	------	6
Pittsburgh	22	------	------	------	1
Porto Rico	------	------	------	280	------
Rhode Island	------	5, 962	7, 155	------	------
St. Lawrence	1, 007	101	3, 017	4, 195	405
San Antonio	26	150	224	213	320
San Francisco	23, 161	8, 124	1, 570	------	5, 784
South Carolina	------	------	------	280	112
Vermont	6	3	119	348	31
Washington	135, 790	113, 004	84, 730	96, 785	76, 301
	417, 226	601, 737	485, 666	549, 843	546, 526

TABLE 77.—*Anthracite imported, by countries and districts, 1924–1928, in net tons*

[Compiled from the records of the Bureau of Foreign and Domestic Commerce]

Country and district	1924	1925	1926	1927	1928
COUNTRY OF ORIGIN					
Australia	1, 836	4, 480	------	------	325
Belgium	------	5, 684	27, 910	------	------
Brazil	------	------	2	------	------
British West Indies (other)	4	12	------	------	------
Canada	16, 249	6, 834	9, 696	3, 391	4, 620
China	------	112	------	------	------
Cuba	------	1	------	------	------
France	------	------	2, 779	------	------
Germany	------	36, 636	198, 011	2	13, 223
Japan	168	3, 946	(1)	2, 778	7, 838
Mexico	94	------	------	------	------
Netherlands	448	6, 485	53, 730	3, 030	5, 471
Peru	------	------	------	------	3
United Kingdom:					
England	99, 152	318, 592	521, 827	109, 829	353, 227
Scotland	------				
Venezuela	------	------	1	------	------
Virgin Islands of the United States	------	112	------	------	------
	117, 951	382, 894	813, 956	119, 030	384, 707

[1] Less than 1 ton.

TABLE 77.—*Anthracite imported, by countries and districts, 1924–1928, in net tons*—Continued

Country and district	1924	1925	1926	1927	1928
DISTRICT OF ENTRY					
Alaska	----------	----------	3	11	----------
Buffalo	16	722	746	1,418	1,177
Connecticut	----------	----------	11,985	----------	----------
Dakota	8,164	724	56	----------	----------
Duluth-Superior	38	64	300	141	----------
Florida	----------	1	----------	----------	----------
Galveston	----------	----------	----------	117	----------
Hawaii	----------	3,492	----------	2,778	7,838
Los Angeles	----------	----------	----------	----------	30
Maine and New Hampshire	22,524	47,543	135,408	24,014	17,542
Maryland	8,296	----------	3,743	----------	2,740
Massachusetts	47,006	117,057	210,918	63,137	307,796
Michigan	317	58	----------	170	----------
Montana-Idaho	5,646	300	----------	----------	----------
New Orleans	7	----------	----------	----------	----------
New York	----------	145,168	393,930	4,490	1,516
Ohio	----------	----------	1	----------	----------
Oregon	1,959	----------	----------	----------	----------
Philadelphia	----------	2,789	27,375	----------	----------
Porto Rico	4	124	----------	----------	----------
Rhode Island	23,110	58,531	29,056	18,865	43,699
St. Lawrence	----------	383	178	112	337
San Antonio	94	----------	----------	----------	----------
San Francisco	493	4,934	9	2	526
Vermont	----------	892	92	143	----------
Washington	277	112	156	3,632	1,506
	117,951	382,894	813,956	119,030	384,707

EXPORTS

General features.—In considering exports, the trade of the United States with Canada must be distinguished from that with other countries. Except for the small shipments to Mexico, the coal trade with other countries is sea borne. The chief characteristic of this seaborne trade during recent years is its uncertainty, for it is relatively new, fluctuating, and at times speculative. It varies with the demand in consuming countries, with mine labor difficulties in producing countries, and more particularly with the prices at which European coal is available for export and with the freight rates prevailing for ocean transport. The trade with Canada, on the other hand, is stable and of long standing.

Trade with Canada and Mexico.—Exports of bituminous coal to Canada in 1928 were 13,958,961 net tons, a decrease of 4.4 per cent from 1927, when Canada's coal consumption was unusually high. (Coal in 1927, p. 449.) The quantity sent to Canada in 1928, however, was somewhat higher than for any of the three years preceding 1927.

As previously noted, exports to Canada and Mexico should be distinguished from the overseas trade. Shipments of bituminous coal to the latter country in 1928 amounted to 91,319 net tons. (See Table 78.) Of this quantity, 85 per cent is known to have been shipped all rail. Thus in 1928 our two nearest neighbors took 14,050,280 tons of bituminous coal. The relative stability of the export movement to these two markets over the past 10 years is indicated in Figure 22.

Shipments of anthracite from the United States to Canada in 1928 were 3,296,487 net tons, an increase of 57,923 tons over 1927 but 5.8 per cent below the average for the five years from 1924 to 1928.

Sea-borne export trade.—The decline in the sea-borne export trade which set in with the settlement of the British strike of 1926 continued in 1928. The total movement of bituminous coal overseas amounted to 2,114,000 net tons, as compared with 3,288,000 tons in 1927 and with an average of 4,254,000 tons for the three years from 1923 to 1925. Exports of American coals to the principal markets in Europe and South America were even below the relatively low level of 1927. In addition, the quantity of bunker coal loaded into vessels engaged in foreign trade in 1928 was 271,056 tons less than in the preceding year and 3,441,383 less than in 1926. (See Table 82.)

In view of recent attempts to stimulate shipments of American coal abroad, the course of the sea-borne export trade over the past 10 years is of special interest. This trend is shown graphically in Figure 22. In pre-war years, overseas exports averaged about 4,000,000 net tons a year. The war at first stimulated but later curtailed exports, as the activity of the submarine cut deeply into the world's supply of shipping. In 1919 the offshore exports were 8,050,000 net tons. In 1920 the export demand was unprecedented, owing to the limitation of exports from Great Britain, and our overseas shipments reached the enormous total of 22,059,000 net tons. The next year, in the face of a world-wide industrial depression, they dropped to 9,541,000 tons and would have dropped still lower but for the fact that for three months exports from the United Kingdom were suspended owing to a strike in that country. The great strike of 1922 dealt the sea-borne export trade a staggering blow. The total dropped to 1,475,000 net tons. The occupation of the Ruhr by the French in 1923 temporarily revived the overseas demand for American

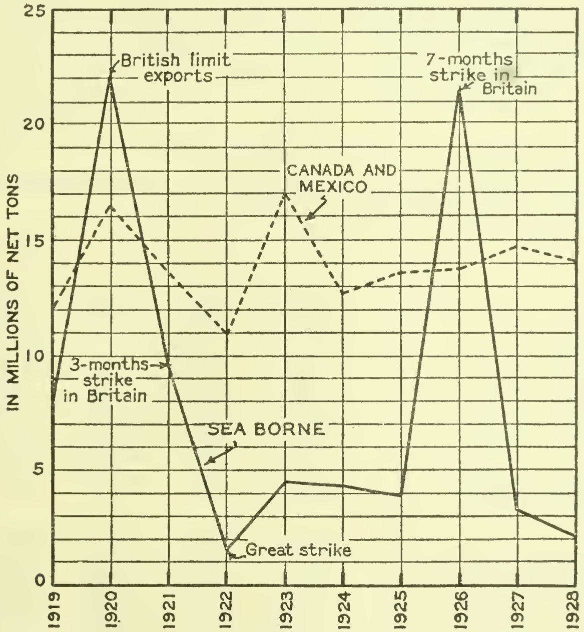

FIGURE 22.—Exports of bituminous coal to Canada and Mexico and overseas, 1919–1928

coal, and for three years, from 1923 to 1925, offshore exports continued at about the pre-war average. In 1926 sea-borne exports increased approximately 450 per cent to 21,510,000 tons, owing to the seven months suspension of production in Great Britain. In the following year there was a tremendous drop and, because of greater competition from abroad, only 3,288,000 tons were shipped overseas. In 1928, sea-borne exports declined still further to 2,114,000 net tons, the smallest offshore movement in any year of ample supplies during the past decade. While mining was curtailed in both 1927 and 1928 in some of the union districts, in no way did this affect the fields supplying the offshore export markets. In both of these years ample supplies of bituminous coal for overseas shipment were constantly available. Ten years of postwar experience have thus shown that labor disputes on one side of the Atlantic or the other are the chief cause of uncertainty in the sea-borne coal trade of the United States, and except during shortages in Europe the overseas demand for American coal has been small.

TABLE 78.—*Bituminous coal exported, by countries, 1924–1928, in net tons*[1]

[Compiled from the records of the Bureau of Foreign and Domestic Commerce]

Country	1924	1925	1926	1927	1928
North America:					
Bermuda	20, 206	13, 470	23, 122	18, 031	11, 554
British Honduras	429	391	562	419	510
Canada	12, 654, 869	13, 421, 007	13, 633, 513	14, 594, 297	13, 958, 961
Central America—					
Costa Rica	3, 836	2	5, 657	5, 788	221
Guatemala	668	3, 401	430	716	755
Honduras	2, 154	2, 018	1, 302	988	1, 352
Nicaragua	5, 990	2, 567	5, 126	602	6, 171
Panama	264, 123	349, 312	445, 305	398, 930	296, 067
Salvador	72	69	128	157	134
Mexico	91, 507	125, 804	128, 633	129, 248	91, 319
Miquelon and St. Pierre Islands	3, 730	12, 443	14, 885	16, 016	3, 735
Newfoundland and Labrador	100, 869	109, 659	83, 545	68, 301	82, 703
West Indies—					
British—					
Barbados	39, 141	37, 583	39, 334	19, 370	32, 638
Jamaica	46, 042	56, 073	159, 533	55, 746	69, 552
Trinidad and Tobago	28, 326	26, 180	59, 353	60, 022	75, 690
Other British	19, 031	36, 745	50, 079	28, 581	22, 942
Cuba	598, 921	694, 125	615, 721	636, 617	599, 600
Dominican Republic	3, 716	8, 028	13, 588	9, 891	1, 192
French	147, 338	139, 385	127, 047	153, 766	154, 012
Haiti	234	67	8, 143	838	187
Netherland	60, 453	86, 090	81, 189	55, 570	47, 668
Virgin Islands of the United States	61, 984	70, 743	95, 118	113, 614	125, 584
	14, 153, 639	15, 195, 162	15, 591, 313	16, 367, 508	15, 582, 547
South America:					
Argentina	220, 058	164, 712	1, 115, 526	236, 018	36, 165
Bolivia	----------	----------	14, 112	----------	----------
Brazil	850, 234	657, 888	1, 333, 640	419, 709	172, 795
Chile	61, 940	27, 280	3, 405	3, 938	----------
Colombia	1, 556	1, 581	18, 669	288	323
Ecuador	3, 423	1, 157	9, 088	293	521
Falkland Islands	----------	----------	11, 862	5, 716	16, 504
Guiana—					
British	18, 314	17, 352	21, 703	11, 667	11, 124
French	----------	258	----------	----------	----------
Surinam (Netherland)	2, 913	2, 726	5, 645	12, 629	11, 253
Paraguay	299	----------	----------	----------	----------
Peru	21, 410	21, 462	29, 683	16, 912	4, 530
Uruguay	68, 803	22, 194	145, 601	33, 179	19, 306
Venezuela	2, 598	811	20, 592	551	523
	1, 251, 548	917, 421	2, 729, 526	740, 900	273, 044

[1] Amounts stated do not include fuel or bunker coal loaded on vessels engaged in the foreign trade, which aggregated, in 1924, 4,460,412 tons; in 1925, 4,865,521 tons; in 1926, 7,735,606 tons; in 1927, 4,565,278 tons; and in 1928, 4,294,223 tons.

TABLE 78.—*Bituminous coal exported, by countries, 1924–1928, in net tons*—Continued

Country	1924	1925	1926	1927	1928
Europe:					
Azores and Madeira Islands			23, 057		
Belgium	17, 164				
Denmark			68, 346	250	
France	471, 401	261, 751	544, 145	119, 642	23, 113
Germany	29, 488	6, 896	1, 273	130	560
Gibraltar			192, 245	14, 324	
Greece	16, 979		28, 925		
Iceland and Faroe Islands			4, 716		
Irish Free State			769, 849	19, 757	363
Italy	975, 146	871, 454	1, 727, 057	359, 654	228, 656
Latvia			8, 716		
Malta, Gozo, etc			30, 903		
Netherlands			31, 674		
Norway		2, 402	92, 133	473	
Poland and Danzig			4, 514		
Portugal			163, 372	36, 052	
Spain	3, 799		18, 751		
Sweden			5, 027		
Turkey in Europe			40, 754		
United Kingdom—					
England	5, 803	18, 124	12, 048, 062	237, 198	2, 274
Scotland					
Ireland					
Yugoslavia and Albania			1, 724	5, 039	
	1, 519, 780	1, 160, 627	15, 805, 243	792, 519	254, 966
Asia:					
Aden				3, 380	22
Arabia				3, 382	
British Malaya				3, 525	
China	4, 355	3, 006			
East Indies—					
British India	1, 138	4, 492			
Netherland	1, 912		3, 418		
Japan	1, 978		194		
Java and Madura	1, 557				
Palestine and Syria			15, 811		
Persia					6
Philippine Islands	6, 440		10, 470	12, 136	1, 120
Soviet Russia in Asia	1	11		11	
	17, 381	7, 509	29, 893	22, 434	1, 148
Africa:					
Algeria and Tunisia	38, 859	35, 607	152, 731	7, 339	7, 166
British—					
East					1, 038
South, Union of					56
West	6, 260	23, 064	20, 854	9, 588	
Canary Islands			290, 303		
Egypt	46, 245	40, 018	359, 434	71, 431	44, 514
French	54, 905	78, 677	122, 185		
Liberia			11		
Morocco			19, 706		
Portuguese—					
Mozambique			3, 920		
Other Portuguese			137, 392		
	146, 269	177, 366	1, 106, 536	88, 358	52, 774
Oceania:					
British—					
Australia		3, 474	8, 298		
New Zealand	4, 349		1, 128		
Other British	7, 381				
French		1		25	6
	11, 730	3, 475	9, 426	25	6
Grand total	17, 100, 347	17, 461, 560	35, 271, 937	18, 011, 744	16, 164, 485

TABLE 79.—*Bituminous coal exported, by districts and ports, 1924–1928, in net tons*

[Compiled from the records of the Bureau of Foreign and Domestic Commerce]

Customs district	Principal ocean port or rail gateway	1924	1925	1926	1927	1928
North Atlantic:						
Massachusetts	Boston	148	692	3	20	2,284
Rhode Island	----------	----------	----------	----------	3	----------
New York	New York	33,534	15,711	108,993	11,265	9,992
Philadelphia	Philadelphia	164,680	194,706	2,224,058	340,011	122,792
Maryland	Baltimore	653,679	336,855	6,465,788	392,366	193,788
Virginia	Hampton Roads	3,632,232	4,260,319	12,205,095	2,587,847	1,858,345
South Atlantic:						
South Carolina	Charleston	135,708	185,833	580,708	230,609	92,688
Georgia	Savannah	----------	196	----------	----------	----------
Florida	Pensacola	4,004	11,629	57,761	1,852	480
Mobile	Mobile	49,495	45,969	35,991	26,905	23,974
New Orleans	New Orleans	6,524	5,547	54,678	3,796	5,470
Galveston	----------	----------	----------	876	488	103
Sabine	----------	----------	853	39	----------	----------
Mexican border:						
Arizona	----------	41,228	62,821	67,290	77,351	33,419
El Paso	----------	34,129	33,950	46,050	36,478	42,334
San Antonio	----------	3,004	2,029	2,326	2,820	1,511
Pacific coast:						
Washington [1]	----------	46,237	58,223	35,723	21,164	24,045
Oregon	----------	602	----------	----------	----------	----------
San Francisco	----------	157	797	645	245	114
Los Angeles	----------	200	96	54	317	149
Lake Erie ports: Ohio [2]	Lower lake docks	5,766,459	5,244,332	5,730,535	6,223,502	6,601,978
Rail gateways on Canadian border:						
Eastern—						
Maine and New Hampshire.	----------	4,941	41,580	50,173	40,389	29,107
Vermont	----------	4,161	3,545	6,208	6,035	4,786
St. Lawrence	----------	1,430,042	1,548,817	1,502,247	1,776,907	1,289,755
Rochester [3]	----------	637,272	572,423	798,741	781,850	1,520,669
Buffalo	----------	2,988,357	2,569,142	2,819,487	2,950,844	2,290,730
Michigan	----------	1,284,609	2,088,046	2,290,484	2,303,082	1,882,254
Western—						
Duluth, Superior, and International Falls.	----------	71,250	70,794	97,815	107,078	74,530
Dakota	----------	100,900	106,503	89,942	88,013	58,889
Montana-Idaho	----------	226	----------	1	6	----------
Miscellaneous:						
Alaska	----------	63	16	11	235	69
Porto Rico	----------	6,506	136	215	266	230
	----------	17,100,347	17,461,560	35,271,937	18,011,744	16,164,485

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[1] Both rail to Canada and by tide to foreign ports.

[2] Lower lake docks as follows: Toledo, Sandusky, Huron, Lorain, Cleveland, Fairport, Ashtabula, Conneaut, and Erie.

[3] Rail, car ferry, and Lake Ontario.

TABLE 80.—*Anthracite exported, by countries, 1924–1928, in net tons*

[Compiled from the records of the Bureau of Foreign and Domestic Commerce]

Country	1924	1925	1926	1927	1928
North America:					
Bermuda	2,053	1,639	896	1,644	2,098
British Honduras	42	353	468		787
Canada	3,927,999	3,096,815	3,941,718	3,238,564	3,296,487
Central America—					
Costa Rica	12		28		2
Guatemala	3	106	141	942	966
Honduras		45	96	84	210
Nicaragua	4	115	1		
Panama	392	920	463	684	435
Salvador	2		16	20	21
Mexico	3,665	809	5,233	8,605	1,674
Miquelon and St. Pierre Islands	200		389	652	105
Newfoundland and Labrador	11,623	10,781	21,690	17,678	17,168
West Indies—					
British—					
Barbados	316		116	56	56
Jamaica		36	29		
Trinidad and Tobago			336		
Other British	174	204	304	148	232
Cuba	63,156	64,994	55,029	50,202	10,887
Dominican Republic	5,341	2,091	702	18	65
Haiti	45		1		
Netherland	1		75	150	69
Virgin Islands of the United States				33	
	4,015,028	3,178,908	4,027,731	3,319,480	3,331,262
South America:					
Argentina			123	179	4
Bolivia			189		
Brazil	6				
Chile	6	3			
Colombia	38	88	78	802	197
Ecuador	1				56
Guiana—British	3		569		
Peru	560	4			
Uruguay			225	94	
Venezuela	24	3	37	39	35
	638	98	1,221	1,114	292
Europe:					
Azores and Madeira Islands			10		
France	670			518	1
Greece			11		
Italy			112		
Portugal			152		
United Kingdom	1,448		401	4,393	3,463
	2,118		686	4,911	3,464
Asia:					
Japan			45		
Philippine Islands					11
Soviet Russia					10
			45		21
Africa:					
Liberia				2	1
Portuguese, other					1,231
				2	1,232
Oceania:					
British	1				
French					1
	1				1
Grand total	4,017,785	3,179,006	4,029,683	3,325,507	3,336,272

TABLE 81.—*Anthracite exported, by districts and ports, 1924–1928, in net tons*

[Compiled from the records of the Bureau of Foreign and Domestic Commerce]

Customs district	Principal ocean port or rail gateway	1924	1925	1926	1927	1928
North Atlantic:						
Massachusetts	Boston	467	477	441	619	454
Rhode Island					5	
Connecticut		45				
New York	New York	110,482	80,117	115,526	100,422	77,215
Philadelphia	Philadelphia	73,148	73,940	80,897	57,430	29,111
Maryland	Baltimore			41		1,014
Virginia	Hampton Roads			84	5,863	101
		184,142	154,534	196,989	164,339	107,895
South Atlantic:						
Georgia	Savannah		44		221	
Florida	Pensacola	3	2	101	8	40
Mobile	Mobile	45		96		50
New Orleans	New Orleans	17	165	143	84	268
Sabine		35				
		100	211	340	313	358
Mexican border:						
Arizona		1,368	29	2,379	513	85
El Paso		1,626	637	1,458	7,115	726
San Antonio		577	73	1,197	862	833
		3,571	739	5,034	8,490	1,644
Pacific coast:						
Washington		3,178	30	231	748	3,360
San Francisco		21		16	20	32
Los Angeles		63	36	103	82	16
		3,262	66	350	850	3,408
Lake Erie ports: Ohio [1]	Lower lake docks	16,908	17,664	20,558	409	9,130
Rail gateways on Canadian border:						
Eastern—						
Maine and New Hampshire		159	340	675	157	206
Vermont		4,509	3,086	3,633	7,748	3,249
St. Lawrence		1,252,786	985,145	1,505,343	1,266,400	1,242,595
Rochester [2]		287,609	205,556	222,584	164,213	237,314
Buffalo		2,220,310	1,769,625	2,041,218	1,691,599	1,708,010
Michigan		7,618	8,961	14,792	5,841	11,859
		3,772,991	2,972,713	3,788,245	3,135,958	3,203,233
Western—						
Duluth, Superior, and International Falls		9,803	12,225	5,615	5,984	4,403
Dakota		27,007	20,854	12,552	9,130	6,201
Montana-Idaho					2	
		36,810	33,079	18,167	15,116	10,604
Miscellaneous: Porto Rico		1			32	
Grand total		4,017,785	3,179,006	4,029,683	3,325,507	3,336,272

[1] Chiefly Buffalo and Erie.

[2] Rail, car ferry, and Lake Ontario.

TABLE 82.—*Anthracite and bituminous coal exported to Canada and to all other countries, by months, 1927 and 1928, in net tons*

[Compiled from the records of the Bureau of Foreign and Domestic Commerce]

	January	February	March	April	May	June	July	August	September	October	November	December	Year
1927													
Anthracite:													
Canada	234,407	198,010	163,309	211,754	335,876	338,268	249,376	302,105	314,664	340,855	302,712	247,228	3,238,564
Overseas and all other	9,924	7,499	7,792	11,339	4,624	2,157	6,131	6,944	10,189	6,414	7,566	6,364	86,943
	244,331	205,509	171,101	223,093	340,500	340,425	255,507	309,049	324,853	347,269	310,278	253,592	3,325,507
Bituminous (not including bunker coal):													
Canada	1,070,685	1,129,005	1,188,144	1,132,143	1,369,479	1,706,099	1,531,116	1,244,745	1,301,614	1,163,168	1,063,235	694,864	14,594,297
Overseas and all other	857,825	386,846	356,627	251,050	163,924	191,230	183,233	190,652	169,554	237,092	191,981	237,433	3,417,447
	1,928,510	1,515,851	1,544,771	1,383,193	1,533,403	1,897,329	1,714,349	1,435,397	1,471,168	1,400,260	1,255,216	932,297	18,011,744
Fuel or bunker coal loaded on vessels engaged in foreign trade	421,570	340,649	360,695	386,173	371,660	399,796	374,983	392,914	413,022	392,986	406,863	303,967	4,565,278
1928													
Anthracite:													
Canada	255,335	244,713	209,963	198,671	291,862	231,501	186,216	308,087	292,188	450,694	339,725	287,532	3,296,487
Overseas and all other	3,953	5,200	1,139	5,316	6,405	2,999	1,135	3,017	2,838	2,791	2,851	2,141	39,785
	259,288	249,913	211,102	203,987	298,267	234,500	187,351	311,104	295,026	453,485	342,576	289,673	3,336,272
Bituminous (not including bunker coal):													
Canada	711,371	675,567	700,765	632,005	1,107,879	1,277,612	1,468,012	1,646,799	1,598,667	1,532,594	1,617,868	989,822	13,958,961
Overseas and all other	242,349	217,071	146,428	164,548	173,877	152,452	214,872	151,945	168,873	144,308	193,696	235,105	2,205,524
	953,720	892,638	847,193	796,553	1,281,756	1,430,064	1,682,884	1,798,744	1,767,540	1,676,902	1,811,564	1,224,927	16,164,485
Fuel or bunker coal loaded on vessels engaged in foreign trade	356,897	299,574	341,824	343,224	407,278	360,900	351,427	399,012	350,025	372,414	374,170	337,478	4,294,223

SHIPMENTS TO ALASKA, HAWAII, AND PORTO RICO

In addition to the export trade proper the United States supplies by sea a small tonnage to the Territories of Alaska, Hawaii, and Porto Rico. As shown in Table 83 the movement to Alaska is relatively steady, but that to Hawaii and Porto Rico tends to fluctuate within wide limits. In 1928, 39,184 tons was shipped coastwise to Alaska, 2,549 tons to Hawaii, and 31,641 tons to Porto Rico.

TABLE 83.—*Shipments of coal to Alaska, Hawaii, and Porto Rico, 1919–1928, in net tons*

[Compiled from the records of the Bureau of Foreign and Domestic Commerce]

Year	Alaska (all coal)	Hawaii (all coal)	Porto Rico (all coal)	Year	Alaska (all coal)	Hawaii (all coal)	Porto Rico (all coal)
1919	57, 166	42, 495	83, 492	1924	40, 161	49, 074	58, 434
1920	38, 128	17, 634	104, 021	1925	37, 324	4, 906	72, 224
1921	24, 278	9, 249	55, 800	1926	35, 620	10, 885	120, 457
1922	28, 457	846	55, 356	1927	39, 443	7, 870	54, 311
1923	34, 082	25, 344	49, 302	1928	39, 184	2, 549	31, 641

WORLD PRODUCTION OF COAL

The world production of coal of all grades in 1928 was 1,450,000,000 metric tons. Of this, approximately 217,000,000 tons was lignite

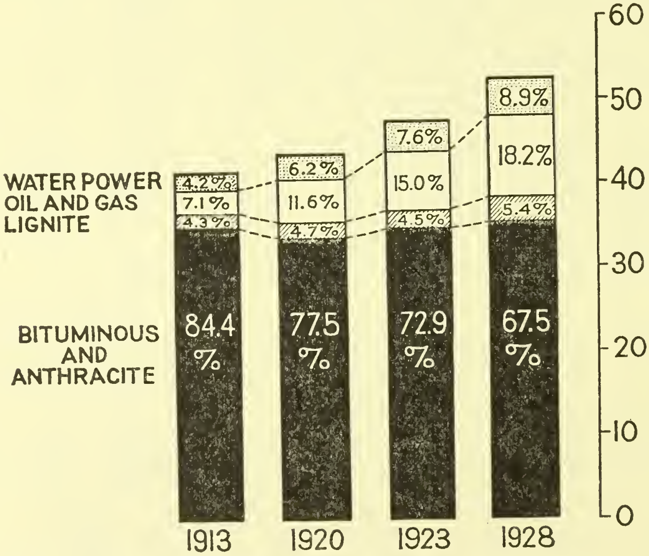

FIGURE 23.—World consumption of coal, oil and gas, and water power, 1913, 1920, 1923, and 1928. Consumption of each source of energy has been reduced to a common denominator in British thermal units. Water power is represented by the amount of fuel necessary to perform the same work. Figures in the bars represent per cent of tota lenergy consumption for the year

and 1,233,000,000 bituminous coal and anthracite. (See fig. 24.) The lignite production was 8.5 per cent above the previous record established in 1927 and represented an increase of 68 per cent over 1913. The production of bituminous coal and anthracite was 40,000,000 metric tons below the output of the preceding year and only 20,000,000 tons larger than in 1913. Some of the tendencies making for a world-wide depression in the coal industry in recent years have been increasing fuel efficiency, successful competition of water power and petroleum, a slowing down in the growth of the iron industry, and the economic disorganization caused in some countries by the World War. (See fig. 23.)

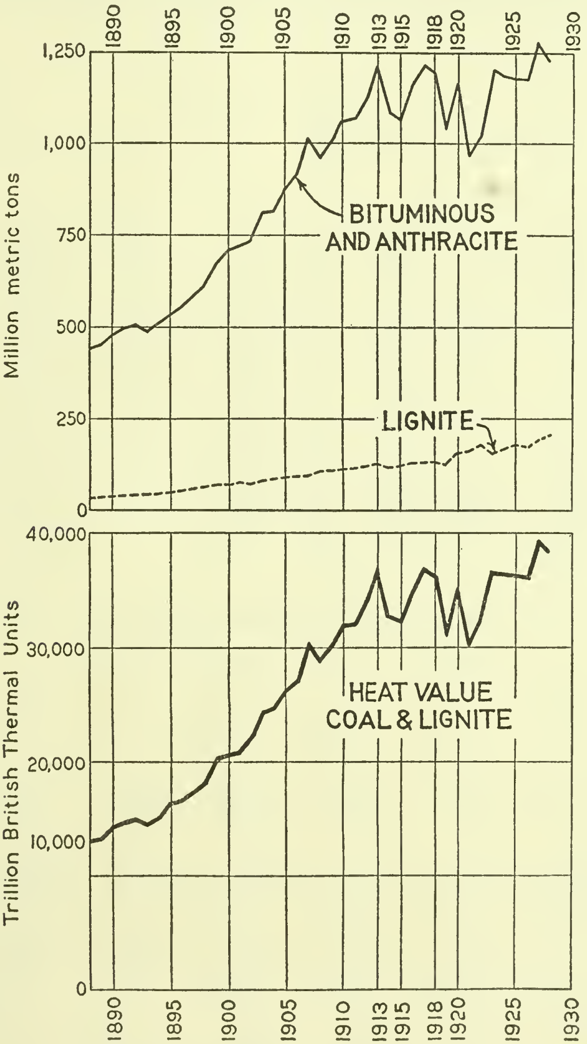

FIGURE 24.—World production of coal and lignite, 1888–1928

Table 85 gives the production of coal by countries from 1924 to 1928. It is based upon official reports, supplemented where necessary by trade information. Similar data by countries for 1888 to 1912 will be found in Coal in 1925, pages 491 to 494; for 1913 to 1922 in Coal in 1922, pages 575 to 577; and for 1923 in Coal in 1923, page 646.

TABLE 84.—*World production of coal and lignite, 1888–1928*

[All countries known to have produced coal are included. Estimates are included for China in the years 1888 to 1905 and for certain of the very small producing countries in the years for which no data were obtainable, but in no year does the tonnage estimated exceed 1.1 per cent of the total]

Year	Million metric tons			Heat value		Year	Million metric tons			Heat value	
	Coal	Lignite	Total	Trillion B. t. u.	Index numbers 1913=100		Coal	Lignite	Total	Trillion B. t. u.	Index numbers 1913=100
1888	442	33	475	13, 226	36. 0	1909	1, 009	106	1, 115	30, 540	83. 2
1889	450	36	486	13, 513	36. 8	1910	1, 059	107	1, 166	32, 001	87. 1
1890	478	38	516	14, 343	39. 1	1911	1, 074	111	1, 185	32, 471	88. 4
1891	498	40	538	14, 942	40. 7	1912	1, 128	120	1, 248	34, 141	93. 0
1892	503	41	544	15, 098	41. 1	1913	1, 213	129	1, 342	36, 724	100. 0
1893	491	43	534	14, 795	40. 3	1914	1, 086	121	1, 207	32, 941	89. 7
1894	514	45	559	15, 498	42. 2	1915	1, 069	124	1, 193	32, 476	88. 4
1895	542	48	590	16, 331	44. 5	1916	1, 159	132	1, 291	35, 164	95. 8
1896	557	51	608	16, 806	45. 8	1917	1, 223	133	1, 356	37, 015	100. 8
1897	584	55	639	17, 636	48. 0	1918	1, 198	135	1, 333	36, 301	98. 8
1898	614	59	673	18, 565	50. 6	1919	1, 044	129	1, 173	31, 799	86. 6
1899	673	62	735	20, 297	55. 3	1920	1, 166	153	1, 319	35, 637	97. 0
1900	708	69	777	21, 386	58. 2	1921	970	164	1, 134	30, 104	82. 0
1901	725	75	800	21, 967	59. 8	1922	1, 047	181	1, 228	32, 536	88. 6
1902	741	73	814	22, 395	61. 0	1923	1, 198	161	1, 359	36, 647	99. 8
1903	813	76	889	24, 509	66. 7	1924	1, 186	171	1, 357	36, 445	99. 2
1904	820	79	899	24, 746	67. 4	1925	1, 187	185	1, 372	36, 624	99. 7
1905	865	84	949	26, 102	71. 1	1926	1, 180	185	1, 365	36, 428	99. 2
1906	924	90	1, 014	27, 884	75. 9	1927	1, 273	200	1, 473	39, 304	107. 0
1907	1, 019	99	1, 118	30, 748	83. 7	1928	1, 233	217	1, 450	38, 354	104. 4
1908	964	105	1, 069	29, 236	79. 6						

TABLE 85.—*Coal and lignite produced in the principal countries of the world in the calendar years 1924–1928, in metric tons*

[Compiled by L. M. Jones, of the Bureau of Mines]

Country	1924	1925	1926	1927	1928
North America:					
Canada—					
Coal	9, 138, 841	8, 627, 519	11, 687, 032	12, 340, 507	12, 444, 575
Lignite	3, 233, 459	3, 288, 262	3, 261, 599	3, 468, 793	3, 489, 400
Greenland	2, 500	2, 100	1, 500	2, 900	3, 000
Mexico	1, 226, 696	1, 444, 498	1, 309, 138	1, 031, 308	1, 021, 426
United States—					
Anthracite	79, 765, 491	56, 079, 281	76, 599, 968	72, 661, 094	68, 354, 261
Bituminous and lignite	438, 790, 754	471, 781, 446	520, 147, 061	469, 704, 558	454, 265, 822
South America:					
Argentina	(1)	(1)	(1)	(1)	(1)
Brazil	342, 200	392, 376	[2] 400, 000	[2] 400, 000	[2] 400, 000
Chile	1, 539, 141	1, 453, 228	1, 490, 509	1, 481, 511	[2] 1, 500, 000
Colombia	(1)	(1)	(1)	(1)	(1)
Peru	151, 735	100, 681	170, 070	158, 601	177, 327
Venezuela [3]	16, 695	16, 798	15, 928	16, 104	15, 812
Europe:					
Albania—Lignite	(1)	(1)	1, 578	3, 008	(1)
Austria—					
Coal	171, 959	145, 200	157, 308	175, 601	202, 098
Lignite	2, 785, 816	3, 033, 378	2, 957, 728	3, 064, 068	3, 262, 570
Belgium	23, 361, 910	23, 097, 040	25, 259, 600	27, 550, 960	27, 542, 780

[1] Estimate included in total.

[2] Approximate production.

[3] Exclusive of output of State of Falcon (about 8,000 tons), for which estimate is included in total.

TABLE 85.—*Coal and lignite produced in the principal countries of the world in the calendar years 1924–1928, in metric tons*—Continued

Country	1924	1925	1926	1927	1928
Europe—Continued.					
Bulgaria—					
Coal	69,670	73,000	62,150	69,192	70,336
Lignite	1,155,291	1,156,006	1,140,093	1,168,454	1,360,790
Czechoslovakia—					
Coal	15,178,942	12,558,992	14,176,998	14,016,300	14,560,305
Lignite	20,459,690	18,604,678	18,515,666	19,620,637	20,451,421
France—					
Coal	44,019,034	47,097,297	51,391,523	51,778,530	51,365,777
Lignite	962,517	993,352	1,061,122	1,067,290	1,063,691
Germany [4]—					
Coal	118,768,748	132,622,125	145,295,724	153,599,355	150,875,814
Lignite	124,637,201	139,724,614	139,150,557	150,503,914	166,224,159
Saar [5]	14,032,120	12,989,850	13,680,874	13,595,824	13,106,718
Greece—Lignite	131,109	142,076	153,321	143,346	120,639
Hungary—					
Coal	744,394	805,019	827,710	785,922	783,279
Lignite	6,333,286	5,520,760	5,822,159	6,244,275	6,508,562
Irish Free State	(1)	(1)	79,715	(1)	(1)
Italy—					
Coal	126,985	188,522	209,260	164,089	132,295
Lignite	917,491	1,105,474	1,181,342	912,458	695,799
Netherlands—					
Coal	6,180,182	7,116,970	8,842,687	9,488,412	10,690,000
Lignite	191,202	207,623	211,194	201,382	
Poland—					
Coal	32,280,482	29,081,327	35,747,348	38,084,086	40,612,971
Lignite	88,688	65,675	76,026	78,464	73,560
Portugal—					
Coal	124,801	123,450	201,732	178,554	(1)
Lignite	8,121	16,970	30,699	25,713	(1)
Rumania—					
Coal	297,288	313,572	322,191	373,457	397,564
Lignite	2,479,083	2,615,278	2,731,362	2,850,011	2,629,676
Russia [6]—					
Coal	12,849,307	13,354,011	20,614,717	25,944,341	30,566,000
Lignite	1,059,754	983,020	1,605,327	1,763,196	
Spain—					
Coal	6,127,586	6,117,342	6,536,087	6,562,936	6,370,508
Lignite	411,773	402,690	399,830	429,602	422,504
Svalbard (Spitsbergen) [7]	451,914	413,412	291,211	303,000	274,000
Sweden	437,856	263,879	383,673	398,298	358,513
Switzerland	(1)	(1)	(1)	7,000	7,000
Turkey—Lignite	(1)	2,000	4,638	4,000	(1)
United Kingdom—					
Great Britain	271,405,414	247,079,210	128,305,291	255,264,615	241,283,355
Northern Ireland—Lignite	(1)	(1)	(1)	510	650
Yugoslavia—					
Coal	131,633	178,456	190,814	287,728	457,472
Lignite	4,053,607	3,973,870	3,976,938	4,458,481	4,694,408
Asia:					
British Borneo	120,613	101,904	92,583	80,466	79,721
China	20,969,000	24,255,000	(1)	(1)	(1)
Chosen	399,415	634,257	682,896	709,578	815,817
Federated Malay States	378,778	414,634	471,736	470,432	565,523
India, British	21,514,131	21,239,892	21,336,204	22,436,757	(1)
Indo-China—					
Coal	1,231,315	1,357,231	1,284,661	1,482,900	1,954,098
Lignite	4,565	5,739	5,598	7,000	15,472
Japan—					
Japan proper—					
Coal	30,000,499	31,369,538	31,296,168	33,387,160	(1)
Lignite	176,764	169,426	161,134	178,613	(1)
Karafuto	199,385	250,615	275,823	357,046	(1)
Taiwan	1,506,451	1,704,581	1,794,511	1,857,257	1,583,598
Netherland East Indies	1,446,757	1,400,725	1,466,359	1,620,205	1,703,474
Philippine Islands	47,938	48,681	28,577	23,410	27,857
Russia [6]—					
Coal	[8] 1,699,571	[8] 1,611,793	[8] 2,849,399	[8] 3,907,499	4,675,000
Lignite	[8] 604,783	[8] 533,880	[8] 687,648	[8] 869,262	
Sakhalin	97,078	17,762	19,624	46,274	
Straits Settlements (Labuan)	10	41	----------	----------	----------
Turkey—					
Coal	1,088,584	703,444	1,222,387	[9] 896,074	[9] 923,403
Lignite	701	4,062	7,569	6,555	5,169

[1] Estimate included in total.

[4] Exclusive of mines in the Saar under French control.

[5] Mines under French control.

[6] Year ended Sept. 30.

[7] Production less consumption at mines, for which data are not available.

[8] Exclusive of Sakhalin.

[9] Shipments.

TABLE 85.—*Coal and lignite produced in the principal countries of the world in the calendar years 1924–1928, in metric tons*—Continued

Country	1924	1925	1926	1927	1928
Africa:					
Algeria	9,228	10,037	13,731	21,269	16,631
Belgian Congo	81,480	65,100	90,250	86,950	97,780
Madagascar				5	33
Nigeria	235,848	242,833	329,784	363,643	[10] 369,581
Portuguese East Africa		18,086	10,868	15,834	6,455
Southern Rhodesia	591,526	689,201	874,140	908,744	1,094,843
Tunisia—Lignite	305				
Union of South Africa	11,819,988	12,321,728	12,949,950	12,580,314	12,606,576
Oceania:					
Australia—					
New South Wales	11,804,688	11,579,108	11,060,483	11,304,688	9,599,841
Queensland	1,141,143	1,196,067	1,240,657	1,116,680	1,093,615
Tasmania	77,208	83,009	104,000	113,854	130,562
Victoria—					
Coal	526,634	542,821	600,487	695,227	668,889
Lignite	129,536	890,535	973,310	1,478,842	1,617,407
Western Australia	428,635	444,482	482,440	509,554	536,901
New Caledonia		1,300	15,000	(1)	(1)
New Zealand—					
Coal	1,102,418	1,044,726	1,215,590	1,299,044	1,370,379
Lignite	1,014,224	1,070,269	1,060,361	1,104,142	1,105,483
Total, all grades	1,357,000,000	1,372,000,000	1,365,000,000	1,473,000,000	1,450,000,000
Lignite (total of items shown above)	171,000,000	185,000,000	185,000,000	200,000,000	217,000,000
Bituminous and anthracite (by subtraction)	1,186,000,000	1,187,000,000	1,180,000,000	1,273,000,000	1,233,000,000

[1] Estimate included in total.

[10] Year ended Mar. 31 of year following that stated.

DETAILED STATISTICS OF BITUMINOUS COAL, BY STATES AND COUNTIES

TABLES OF PRODUCTION, VALUE, MEN EMPLOYED, DAYS WORKED, AND OUTPUT PER MAN IN 1928

The following table (No. 86) presents detailed statistics for each coal-producing county from which three or more operators reported production. If less than three reports were received the figures for two or more counties have been combined to avoid disclosing individual returns, unless permission to publish has been granted by the producers.

The series gives the details of total value of product, average value per ton, men employed by broad occupational groups, average number of days worked by the mines, and output per man per day. The figures include stripping operations as well as deep mines. Separate particulars for the stripping operations in each county are given in Table 46. If the reader will deduct the stripping figures as given in that table from the totals for all mines in the following table, he will find that the remainder represents the operations of the deep mines. By this means figures can be obtained for the deep mines separately in any State or county desired.

TABLE 86.—*Production, value, men employed, days worked, and output per man per day at bituminous coal mines in specified States and counties in 1928*

[Note that figures relate only to active mines of commercial size; no canvass made of wagon mines producing less than 1,000 tons]

County	Net tons					Value		Number of employees					Average number of days worked	Average tons per man per day
								Underground						
	Loaded at mines for shipment	Sold to local trade and used by employees	Used at mines for power and heat	Made into coke at mines	Total quantity	Total	Average per ton	Miners, loaders, and shot firers	Haulage and track	All others	Surface	Total		
ALABAMA														
Bibb	1,129,807	6,638	17,535	----------	1,153,980	$2,863,000	$2.48	1,189	153	251	284	1,877	211	2.92
Blount	340,455	8,753	8,093	----------	357,301	803,000	2.25	438	91	25	120	674	211	2.51
Etowah and St. Clair	728,966	5,283	37,984	----------	772,233	1,705,000	2.21	525	74	87	124	810	232	4.11
Fayette and Marion	341,888	4,065	300	----------	346,253	1,016,000	2.93	398	56	45	93	592	210	2.79
Jefferson	8,379,841	136,976	110,858	----------	8,627,675	19,946,000	2.31	6,940	1,409	1,796	1,673	11,818	246	2.96
Shelby	651,567	30,257	759	----------	682,583	2,246,000	3.29	1,008	149	86	258	1,501	240	1.89
Tuscaloosa	592,613	9,346	1,220	----------	603,179	1,385,000	2.30	682	125	89	185	1,081	217	2.57
Walker	4,827,751	230,645	14,094	----------	5,072,490	9,624,000	1.90	4,368	933	811	1,215	7,327	184	3.75
Winston	4,050	1,618	----------	----------	5,668	13,000	2.29	18	2	2	6	28	136	1.49
	16,996,938	433,581	190,843	----------	17,621,362	39,601,000	2.25	15,566	2,992	3,192	3,958	25,708	222	3.09
ALASKA														
Total	118,440	6,400	1,260	----------	126,100	$662,000	$5.25	51	10	24	48	133	224	4.23
ARIZONA														
Total	----------	3,600	----------	----------	3,600	$16,000	$4.44	11	----------	----------	1	12	208	1.45
ARKANSAS														
Franklin	267,983	2,366	4,623	----------	274,972	$824,000	$3.00	253	32	39	165	489	186	3.02
Johnson	293,765	526	3,717	----------	298,008	1,291,000	4.33	831	137	132	229	1,329	90	2.49
Logan	183,694	3,596	4,353	----------	191,643	901,000	4.70	427	54	60	73	614	128	2.44
Sebastian	782,522	4,083	5,416	----------	792,021	2,054,000	2.59	926	179	132	163	1,400	183	3.09
Other counties (Pope and Scott)	99,586	4,439	304	----------	104,329	545,000	5.22	183	30	16	31	260	195	2.06
	1,627,550	15,010	18,413	----------	1,660,973	5,615,000	3.38	2,620	432	379	661	4,092	146	2.79

TABLE 86.—*Production, value, men employed, days worked, and output per man per day at bituminous coal mines in specified States and counties in 1928*—Continued

CALIFORNIA, IDAHO, AND OREGON

County	Net tons					Value		Number of employees					Average number of days worked	Average tons per man per day
								Underground						
	Loaded at mines for shipment	Sold to local trade and used by employees	Used at mines for power and heat	Made into coke at mines	Total quantity	Total	Average per ton	Miners, loaders, and shot firers	Haulage and track	All others	Surface	Total		
Total	18,235	4,003	1,650		23,888	$70,000	$2.93	43	7	16	18	84	177	1.61

COLORADO

County	Loaded at mines for shipment	Sold to local trade and used by employees	Used at mines for power and heat	Made into coke at mines	Total quantity	Value: Total	Value: Average per ton	Miners, loaders, and shot firers	Haulage and track	All others	Surface	Total	Average number of days worked	Average tons per man per day
Boulder	308,924	93,446	25,825		428,195	$1,142,000	$2.67	425	94	58	69	646	169	3.93
Delta	42,120	28,049	350		70,519	195,000	2.77	63	7	4	20	94	131	5.73
Dolores and San Miguel		8,783	180		8,963	20,000	2.23	8	1	1	1	11	257	3.17
Elbert	240	3,879			4,119	10,000	2.43	13	1	1	2	17	153	1.58
El Paso	130,037	206,043	13,666		349,746	913,000	2.61	245	53	20	46	364	236	4.07
Fremont	396,980	71,187	4,334		472,501	1,822,000	3.86	500	112	72	151	835	220	2.57
Garfield	8,887	26,886			35,773	102,000	2.85	35	4	3	3	45	232	3.43
Gunnison	437,019	7,689	18,136		462,844	1,319,000	2.85	392	123	69	118	702	154	4.29
Huerfano	1,736,667	24,851	19,876		1,781,394	5,974,000	3.35	1,709	315	233	461	2,718	187	3.51
Jefferson	77,495	11,737	11,177		100,409	238,000	2.37	73	17	10	17	117	208	4.12
La Plata	21,248	47,800		17,520	86,568	286,000	3.30	85	8	11	17	121	225	3.18
Las Animas	2,612,768	45,066	36,171	216,626	2,910,631	7,441,000	2.56	2,438	435	304	470	3,647	213	3.75
Mesa	124,832	32,806	2,410		160,048	356,000	2.22	134	13	5	12	164	249	3.92
Moffat		4,891	5		4,896	11,000	2.25	7	1	1	1	10	174	2.82
Montezuma		6,086			6,086	34,000	5.59	8	2	2	2	14	199	2.19
Rio Blanco		5,165			5,165	16,000	3.10	6	1	1	2	10	188	2.75
Routt	881,360	15,402	32,428		929,190	3,365,000	3.62	714	124	130	272	1,240	107	[1] 6.99
Weld	1,766,971	151,326	29,089		1,947,386	4,161,000	2.14	1,083	138	157	129	1,507	218	[1] 5.92
Other counties (Jackson, Montrose, and Pitkin)	75,992	4,063	3,219		83,274	208,000	2.50	56	14	15	19	104	256	3.16
	8,621,540	795,155	196,866	234,146	9,847,707	27,613,000	2.80	7,994	1,463	1,097	1,812	12,366	193	4.13

GEORGIA

County	Loaded at mines for shipment	Sold to local trade and used by employees	Used at mines for power and heat	Made into coke at mines	Total quantity	Value: Total	Value: Average per ton	Miners, loaders, and shot firers	Haulage and track	All others	Surface	Total	Average number of days worked	Average tons per man per day
Total	56,487	596	259	1,048	58,390	$181,000	$3.10				124	124	280	1.68

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[1] In this county certain mines have in recent times followed the practice of reducing their forces in periods of dull market and of working every day underground when the tipple works only 1, 2, or 3 days a week. As the figures of days worked represent tipple time, the result is not comparable with the returns for other counties, and the average for the State is affected also.

ILLINOIS

Bond, Clinton, and Marion	1, 015, 205	83, 042	52, 475	------	1, 150, 722	$2, 054, 000	$1. 78	1, 049	171	212	226	1, 658	127	5. 47
Bureau	------	4, 784	------	------	4, 784	17, 000	3. 55	28	1	1	2	32	75	2. 00
Cass and Morgan	------	1, 973	------	------	1, 973	6, 000	3. 04	5	1	1	1	8	181	1. 37
Christian	3, 441, 404	148, 238	27, 642	------	3, 617, 284	7, 065, 000	1. 95	2, 589	313	343	239	3, 484	179	5. 80
Edgar, Logan, and Macon	122, 776	177, 252	5, 171	------	305, 199	829, 000	2. 72	432	76	66	64	638	167	2. 87
Franklin	13, 687, 364	141, 584	115, 384	------	13, 944, 332	28, 594, 000	2. 05	9, 330	1, 846	1, 619	1, 282	14, 077	171	5. 81
Fulton	1, 498, 401	169, 692	7, 614	------	1, 675, 707	3, 254, 000	1. 94	1, 042	157	100	270	1, 569	161	6. 62
Gallatin	7, 385	13, 727	1, 216	------	22, 328	44, 000	1. 97	109	9	10	15	143	47	3. 35
Greene	------	6, 336	------	------	6, 336	20, 000	3. 16	13	1	1	1	16	142	2. 78
Grundy	429, 575	26, 798	1, 617	------	457, 990	1, 110, 000	2. 42	251	49	58	30	388	255	4. 63
Hancock	------	6, 418	------	------	6, 418	25, 000	5. 45	12	1	1	1	15	120	3. 57
Henry	2, 000	44, 243	955	------	47, 198	141, 000	2. 99	88	7	9	12	116	168	2. 42
Jackson	843, 025	55, 468	2, 593	------	901, 086	1, 236, 000	1. 37	110	11	4	229	354	196	[2] 13. 02
Jefferson and White	48, 440	6, 008	9, 396	------	63, 844	117, 000	1. 83	106	15	8	27	156	111	3. 68
Knox	104, 434	35, 004	300	------	139, 738	388, 000	2. 78	150	11	8	11	180	211	3. 68
La Salle	156, 922	258, 989	4, 368	------	420, 279	1, 115, 000	2. 65	793	68	105	104	1, 070	160	2. 46
Livingston	------	22, 050	423	------	22, 473	81, 000	3. 60	35	5	5	24	69	140	2. 32
McDonough	2, 448	5, 357	------	------	7, 805	35, 000	4. 48	22	2	2	2	28	167	1. 67
McLean, Will, and Woodford	282, 147	26, 337	4, 027	------	312, 511	640, 000	2. 05	300	23	28	123	474	131	5. 05
Macoupin	4, 497, 835	57, 516	94, 954	------	4, 650, 305	8, 959, 000	1. 93	2, 433	442	598	346	3, 819	178	6. 83
Madison	2, 050, 677	168, 848	34, 310	------	2, 253, 835	4, 216, 000	1. 87	2, 134	314	348	288	3, 084	131	5. 57
Marshall	------	12, 334	------	------	12, 334	20, 000	1. 62	20	2	2	1	25	224	2. 20
Menard	250	71, 279	2, 494	------	74, 023	204, 000	2. 76	125	11	10	13	159	168	2. 77
Mercer	1, 500	32, 417	830	------	34, 747	108, 000	3. 11	58	4	3	8	73	175	2. 72
Montgomery	1, 351, 831	26, 475	30, 095	------	1, 408, 401	2, 647, 000	1. 88	910	173	288	123	1, 494	140	6. 75
Peoria	1, 283, 329	219, 944	5, 208	------	1, 508, 481	3, 305, 000	2. 19	1, 203	181	97	111	1, 592	228	4. 16
Perry	2, 118, 525	150, 703	37, 536	------	2, 036, 764	4, 389, 000	1. 90	1, 134	175	112	407	1, 828	159	7. 94
Randolph	573, 702	42, 953	16, 022	------	632, 677	1, 200, 000	1. 90	771	131	49	81	1, 032	112	5. 46
Rock Island	------	20, 897	720	------	21, 617	59, 000	2. 73	43	3	6	7	59	119	3. 07
St. Clair	2, 435, 302	458, 245	66, 579	------	2, 960, 126	5, 083, 000	1. 72	2, 454	411	395	394	3, 654	137	5. 92
Saline	3, 527, 869	57, 553	60, 107	------	3, 645, 529	6, 957, 000	1. 91	3, 211	728	320	497	4, 756	154	4. 99
Sangamon	3, 316, 469	351, 369	40, 893	------	3, 708, 731	7, 994, 000	2. 16	4, 825	509	566	361	6, 261	134	4. 42
Schuyler	------	16, 745	600	------	17, 345	41, 000	2. 36	30	2	2	2	36	192	2. 52
Shelby	5, 332	20, 651	3, 746	------	29, 729	92, 000	3. 09	71	8	14	12	105	117	2. 42
Stark	------	9, 887	------	------	9, 887	33, 000	3. 34	22	2	2	2	28	183	1. 93
Tazewell	435, 114	139, 346	2, 412	------	576, 872	1, 258, 000	2. 18	438	39	54	59	590	249	3. 93
Vermilion	2, 958, 854	366, 711	32, 517	------	3, 358, 082	7, 294, 000	2. 17	2, 130	294	546	412	3, 382	183	5. 43
Wabash	------	4, 267	------	------	4, 267	10, 000	2. 34	9	1	1	2	13	133	2. 48
Warren	------	8, 872	------	------	8, 872	36, 000	4. 06	11	1	1	1	14	190	3. 34
Washington	383, 710	99, 213	19, 097	------	502, 020	1, 032, 000	2. 06	156	57	50	48	311	241	6. 70
Williamson	4, 931, 584	102, 680	81, 284	------	5, 115, 548	10, 377, 000	2. 03	5, 066	875	636	899	7, 476	118	5. 80
	51, 513, 409	3, 672, 205	762, 585	------	55, 948, 199	112, 095, 000	2. 00	43, 718	7, 130	6, 681	6, 737	64, 266	156	[3] 5. 57

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[2] Much of the output of this county is obtained from strip pits, in which the production per man is large.

[3] The figure of 5.57 tons per man per day for Illinois is not comparable with earlier years, although computed in exactly the same way. It is obtained by dividing the tonnage produced by the total number of man-days worked, the latter being calculated for each mine by multiplying the average number of men employed by the number of days that the mine worked. This method of calculation is the best one feasible in the light of the records kept by the majority of American coal operators and the results are generally comparable from year to year. In Illinois during 1928, however, some operators installing mechanical loading for the first time pursued the practice of dividing up the work among the men already on their pay rolls in order to avoid discharging men. For this reason the number of men reported as employed in 1928 (64,266) is considerably in excess of the number actually at work on any one day. Were it possible to allow for this fact, the output per man per day would appear materially higher than 5.57 tons. Even so, it shows a notable increase over the 5.36 tons reported in 1927.

TABLE 86.—*Production, value, men employed, days worked, and output per man per day at bituminous coal mines in specified States and counties in 1928*—Continued

INDIANA

County	Net tons					Value		Number of employees					Average number of days worked	Average tons per man per day
								Underground						
	Loaded at mines for shipment	Sold to local trade and used by employees	Used at mines for power and heat	Made into coke at mines	Total quantity	Total	Average per ton	Miners, loaders, and shot firers	Haulage and track	All others	Surface	Total		
Clay	830, 258	23, 290	30, 409		883, 957	$1, 608, 000	$1. 82	327	48	52	354	781	192	5. 91
Daviess	53, 853	19, 106	2, 947		75, 906	113, 000	1. 49	76	8	14	14	112	193	3. 52
Fountain and Parke		2, 230			2, 230	6, 000	2. 69	7	1	1	1	10	80	2. 79
Gibson	1, 063, 806	23, 605	16, 738		1, 104, 149	1, 951, 000	1. 77	503	116	96	115	830	183	7. 29
Greene	1, 389, 740	22, 230	27, 648		1, 439, 618	2, 446, 000	1. 70	592	99	101	275	1, 067	158	8. 54
Knox	375, 244	40, 816	2, 880		418, 940	677, 000	1. 62	773	102	149	112	1, 136	61	6. 02
Owen	20, 700	1, 351	1, 404		23, 455	41, 000	1. 75	30	8	2	4	44	156	3. 43
Perry, Spencer, and Vanderburg	160, 230	136, 322	7, 256		303, 808	578, 000	1. 90	238	46	41	48	373	153	5. 31
Pike	1, 883, 472	28, 880	37, 226		1, 949, 578	3, 041, 000	1. 56	280	55	85	792	1, 212	142	11. 33
Sullivan	2, 885, 629	35, 381	63, 468		2, 984, 478	5, 991, 000	2. 01	2, 148	440	453	503	3, 544	161	5. 24
Vermillion	1, 985, 676	45, 969	29, 131		2, 060, 776	3, 666, 000	1. 78	1, 431	308	103	262	2, 104	149	6. 57
Vigo	3, 130, 168	146, 706	87, 738		3, 364, 612	6, 724, 000	2. 00	2, 883	465	501	400	4, 249	136	5. 81
Warrick	1, 709, 606	39, 044	18, 423		1, 767, 073	2, 370, 000	1. 34	679	163	137	365	1, 344	190	6. 91
	15, 488, 382	564, 930	325, 268		16, 378, 580	29, 212, 000	1. 78	9, 967	1, 859	1, 735	3, 245	16, 806	150	6. 51

IOWA

County	Loaded at mines for shipment	Sold to local trade and used by employees	Used at mines for power and heat	Made into coke at mines	Total quantity	Value: Total	Value: Average per ton	Miners, loaders, and shot firers	Haulage and track	All others	Surface	Total	Average number of days worked	Average tons per man per day
Adams and Page		31, 952			31, 952	$96, 000	$3. 00	47	4	3	5	59	233	2. 32
Appanoose	394, 772	69, 629	885		465, 286	1, 310, 000	2. 82	1, 111	122	80	109	1, 422	159	2. 06
Boone	323, 633	70, 860	3, 383		397, 876	1, 460, 000	3. 67	646	89	133	47	915	171	2. 54
Dallas	272, 394	8, 469	1, 178		282, 041	810, 000	2. 87	477	58	58	47	640	139	3. 16
Davis, Jefferson, and Keokuk		4, 760	10		4, 770	17, 000	3. 56	18	2	1	3	24	102	1. 94
Greene and Webster		9, 239	240		9, 479	33, 000	3. 48	18	3	3	4	28	168	2. 01
Guthrie		9, 131			9, 131	36, 000	3. 94	30	2	4	4	40	124	1. 84
Jasper	3, 741	41, 066	2, 815		47, 622	137, 000	2. 88	66	10	8	13	97	149	3. 30
Lucas	300, 710	28, 087	8, 838		337, 635	1, 020, 000	3. 02	243	105	43	34	425	161	4. 93
Mahaska		52, 241	86		52, 327	138, 000	2. 64	127	4	6	10	147	152	2. 34
Marion	776, 173	54, 695	17, 426		848, 294	2, 017, 000	2. 38	666	147	106	56	975	213	4. 08
Monroe	321, 889	25, 498	4, 377		351, 764	942, 000	2. 68	535	50	64	52	701	174	2. 89
Polk	298, 107	269, 633	7, 614		575, 354	1, 688, 000	2. 93	657	125	78	69	929	206	3. 00

Taylor	4, 206	11, 118	----------	----------	15, 324	63, 000	4. 11	43	2	6	3	54	175	1. 62
Van Buren	4, 285	5, 954	100	----------	10, 339	31, 000	3. 00	27	2	1	1	31	154	2. 17
Wapello	3, 281	58, 163	----------	----------	61, 444	182, 000	2. 96	118	9	12	13	152	154	2. 63
Warren	146, 157	10, 691	5, 945	----------	162, 793	481, 000	2. 95	173	31	35	25	264	176	3. 50
Wayne	----------	20, 204	----------	----------	20, 204	64, 000	3. 17	53	1	3	5	62	161	2. 02
	2, 849, 348	781, 390	52, 897	----------	3, 683, 635	10, 525, 000	2. 86	5, 055	766	644	500	6, 965	175	3. 02
KANSAS														
Bourbon	1, 740	25, 589	----------	----------	27, 329	$64, 000	$2. 34	----------	----------	----------	59	59	162	3. 09
Cherokee	678, 014	84, 148	12, 771	----------	774, 933	1, 759, 000	2. 27	460	28	21	278	787	136	7. 26
Crawford	1, 662, 367	126, 534	24, 968	----------	1, 813, 869	4, 501, 000	2. 48	2, 969	314	157	700	4, 140	109	4. 03
Franklin and Leavenworth	35, 000	51, 550	2, 500	----------	89, 050	178, 000	2. 00	313	58	52	53	476	278	. 67
Linn	18, 551	17, 510	----------	----------	36, 061	74, 000	2. 05	106	10	7	12	135	112	2. 38
Osage	37, 877	30, 408	197	----------	68, 482	285, 000	4. 16	305	36	24	29	394	131	1. 32
	2, 433, 549	335, 739	40, 436	----------	[4] 2, 809, 724	6, 861, 000	2. 44	4, 153	446	261	1, 131	5, 991	128	3. 68
KENTUCKY														
Eastern district:														
Bell	2, 953, 392	73, 141	16, 572	----------	3, 043, 105	$4, 971, 000	$1. 63	2, 383	442	351	499	3, 675	217	3. 81
Boyd	66, 838	7, 706	----------	----------	74, 544	116, 000	1. 56	88	13	6	15	122	228	2. 68
Breathitt	188, 557	1, 930	9, 900	----------	200, 387	295, 000	1. 47	181	39	46	42	308	229	2. 84
Clay	66, 241	1, 030	1, 530	----------	68, 801	109, 000	1. 58	123	10	9	30	172	138	2. 91
Floyd	4, 753, 653	38, 591	35, 616	----------	4, 827, 860	8, 100, 000	1. 68	3, 040	689	649	710	5, 088	220	4. 32
Harlan	14, 230, 585	85, 996	45, 004	65, 859	14, 427, 444	25, 531, 000	1. 77	7, 024	1, 414	1, 237	1, 514	11, 189	259	4. 98
Johnson	1, 210, 404	14, 356	15, 826	----------	1, 240, 586	2, 779, 000	2. 24	883	152	160	172	1, 367	244	3. 71
Knott	565, 472	3, 415	----------	----------	568, 887	855, 000	1. 50	283	55	46	85	469	203	5. 97
Knox	262, 523	7, 993	5, 750	----------	276, 266	433, 000	1. 57	283	40	22	60	405	213	3. 21
Laurel	98, 945	50	168	----------	99, 163	170, 000	1. 71	180	12	19	18	229	223	1. 94
Letcher	5, 733, 878	50, 811	68, 225	----------	5, 852, 914	9, 999, 000	1. 71	3, 392	860	1, 019	801	6, 072	216	4. 46
McCreary	914, 207	16, 830	360	----------	931, 397	1, 559, 000	1. 67	802	166	168	145	1, 281	185	3. 93
Magoffin	93, 573	800	3, 300	----------	97, 673	145, 000	1. 48	88	23	31	29	171	125	4. 58
Martin	278, 645	2, 070	10	----------	280, 725	323, 000	1. 15	251	49	38	47	385	114	6. 41
Perry	5, 741, 893	86, 815	----------	----------	5, 828, 708	9, 135, 000	1. 57	3, 235	776	744	871	5, 626	221	4. 69
Pike	6, 983, 154	55, 436	34, 559	----------	7, 073, 149	10, 696, 000	1. 51	3, 603	844	937	1, 063	6, 447	233	4. 72
Whitley	603, 365	5, 381	16, 828	----------	625, 574	1, 248, 000	1. 99	760	61	87	179	1, 087	189	3. 04
Other counties (Carter, Lawrence, Lee, Morgan, and Wayne)	11, 690	52, 558	1, 732	----------	65, 980	166, 000	2. 52	119	20	8	47	194	201	1. 69
	44, 757, 015	504, 909	255, 380	65, 859	45, 583, 163	76, 630, 000	1. 68	26, 718	5, 665	5, 577	6, 327	44, 287	228	4. 51

[2] Much of the output of this county is obtained from strip pits, in which the production per man is large.

[4] In comparing these figures with the records of the State coal-mine inspection department, it should be noted that the State department includes an allowance of 500,000 tons produced by unspecified "Miscellaneous mines."

TABLE 86.—*Production, value, men employed, days worked, and output per man per day at bituminous coal mines in specified States and counties in 1928*—Continued

KENTUCKY—Continued

County	Net tons					Value		Number of employees					Average number of days worked	Average tons per man per day
								Underground						
	Loaded at mines for shipment	Sold to local trade and used by employees	Used at mines for power and heat	Made into coke at mines	Total quantity	Total	Average per ton	Miners, loaders, and shot firers	Haulage and track	All others	Surface	Total		
Western district:														
Daviess	50,308	91,699	1,219	----------	143,226	$190,000	$1.33	124	24	11	23	182	199	3.95
Henderson	280,585	72,322	13,900	----------	366,807	496,000	1.35	295	75	51	43	464	192	4.12
Hopkins	5,131,754	88,045	23,975	----------	5,243,774	6,552,000	1.25	3,395	429	979	860	5,663	165	5.62
McLean	97,363	175	5,260	----------	102,798	131,000	1.27	111	27	11	17	166	150	4.14
Muhlenberg	5,272,109	62,055	87,423	----------	5,421,587	6,504,000	1.20	3,638	515	1,005	659	5,817	168	5.54
Ohio	963,781	6,624	20,872	----------	991,277	1,257,000	1.27	1,099	269	57	169	1,594	140	4.43
Union	1,114,487	39,608	35,184	----------	1,189,279	1,478,000	1.24	708	101	285	146	1,240	203	4.73
Webster	2,726,140	19,409	10,876	----------	2,756,425	3,376,000	1.22	1,618	265	470	290	2,643	198	5.26
Other counties (Christian and Crittenden)	61,164	150	729	----------	62,043	108,000	1.74	95	13	14	17	139	150	2.97
	15,697,691	380,087	199,438	----------	16,277,216	20,092,000	1.23	11,083	1,718	2,883	2,224	17,908	172	5.28
Total, all Kentucky	60,454,706	884,996	454,818	65,859	61,860,379	96,722,000	1.56	37,801	7,383	8,460	8,551	62,195	212	4.69
MARYLAND														
Allegany	1,890,903	99,204	3,869	----------	1,993,976	$3,823,000	$1.92	1,639	281	249	259	2,428	246	3.34
Garrett	673,196	12,093	7,714	----------	693,003	1,131,000	1.63	586	106	62	122	876	197	4.02
	2,564,099	111,297	11,583	----------	2,686,979	4,954,000	1.84	2,225	387	311	381	3,304	233	3.50
MICHIGAN														
Bay, Midland, and Saginaw	566,587	7,637	43,118	----------	617,342	$2,631,000	$4.26	818	174	127	120	1,239	187	2.67
	566,587	7,637	43,118	----------	617,342	2,631,000	4.26	818	174	127	120	1,239	187	2.67

MISSOURI

Adair	135, 070	20, 479	6, 763	----------	162, 312	$361, 000	$2. 22	249	67	41	27	384	175	2. 42
Audrain	----------	10, 312	58	----------	10, 370	51, 000	4. 92	30	5	7	4	46	177	1. 27
Barton	1, 344, 814	6, 695	22, 821	----------	1, 374, 330	3, 295, 000	2. 40	235	20	17	602	874	150	[4] 10. 50
Bates	162, 640	29, 923	1, 350	----------	193, 913	409, 000	2. 11	173	19	18	134	344	150	3. 76
Boone	----------	35, 769	24	----------	35, 793	117, 000	3. 27	84	12	8	18	122	200	1. 46
Caldwell and Platte	10, 870	18, 869	3, 102	----------	32, 841	170, 000	5. 18	117	6	9	12	144	124	1. 85
Callaway	----------	34, 691	12	----------	34, 703	129, 000	3. 72	67	6	7	29	109	214	1. 49
Cedar and Vernon	104, 957	4, 000	2, 612	----------	111, 569	246, 000	2. 20	29	3	1	127	160	135	5. 15
Chariton	----------	7, 915	----------	----------	7, 915	26, 000	3. 28	20	2	3	2	27	188	1. 56
Clay	42, 664	14, 309	242	----------	57, 215	186, 000	3. 25	155	33	22	15	225	152	1. 67
Grundy, Harrison, and Schuyler	7, 622	7, 808	390	----------	15, 820	63, 000	3. 98	57	8	11	8	84	141	1. 33
Henry	200, 436	36, 960	11, 500	----------	248, 896	556, 000	2. 23	24	2	2	116	144	222	[5] 7. 77
Howard and Ralls	78, 519	6, 540	135	----------	85, 194	195, 000	2. 29	37	1	4	65	107	182	4. 39
Johnson	39, 580	5, 446	1, 380	----------	46, 406	124, 000	2. 67	63	5	5	9	82	267	2. 12
Lafayette	429, 538	54, 839	9, 153	----------	493, 530	1, 385, 000	2. 81	671	61	154	67	953	231	2. 24
Linn	8, 991	19, 409	----------	----------	28, 400	106, 000	3. 73	89	7	4	11	111	160	1. 60
Macon	180, 912	30, 523	5, 356	----------	216, 791	532, 000	2. 45	323	39	27	41	430	205	2. 46
Monroe	----------	4, 093	----------	----------	4, 093	19, 000	4. 64	11	2	2	2	17	135	1. 79
Putnam	9, 442	14, 225	6	----------	23, 673	63, 000	2. 66	114	7	4	9	134	111	1. 59
Randolph	113, 672	60, 670	4, 897	----------	179, 239	473, 000	2. 64	306	45	32	38	421	200	2. 12
Ray	326, 678	41, 228	1, 512	----------	369, 418	1, 131, 000	3. 06	843	71	70	62	1, 046	170	2. 07
	3, 196, 405	464, 703	71, 313	----------	3, 732, 421	9, 637, 000	2. 58	3, 697	421	448	1, 398	5, 964	180	3. 47

MONTANA

Blaine, Chouteau, Hill, Pondera, and Toole	1, 064	22, 781	117	----------	23, 962	$81, 000	$3. 38	31	4	2	4	41	241	2. 43
Carbon	714, 934	20, 107	33, 417	----------	768, 458	2, 322, 000	3. 02	488	115	84	151	838	192	4. 77
Cascade	222, 077	8, 677	402	----------	231, 156	606, 000	2. 62	161	39	11	31	242	192	4. 98
Daniels, Dawson, Richland, and Wibaux	16, 022	16, 950	28	----------	33, 000	73, 000	2. 21	23	5	3	7	38	218	3. 99
Fergus	----------	1, 820	----------	----------	1, 820	4, 000	2. 20	5	1	1	1	8	81	2. 82
Judith Basin	----------	3, 922	----------	----------	3, 922	12, 000	3. 06	6	2	1	1	10	173	2. 27
Musselshell	1, 035, 184	7, 783	9, 971	----------	1, 052, 938	2, 617, 000	2. 49	563	112	94	116	885	178	6. 70
Roosevelt	----------	5, 002	----------	----------	5, 002	14, 000	2. 80	9	1	1	1	12	148	2. 83
Rosebud	1, 180, 134	1, 200	870	----------	1, 182, 204	1, 775, 000	1. 50	3	1	1	76	81	314	[4] 46. 44
Sheridan	----------	21, 688	45	----------	21, 733	46, 000	2. 12	30	2	2	2	36	192	3. 14
	3, 169, 415	109, 930	44, 850	----------	3, 324, 195	7, 550, 000	2. 27	1, 319	282	200	390	2, 191	191	7. 93

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[4] The output of this county is chiefly obtained from strip pits, in which the production per man per day is large.

[5] The output of this county is obtained from strip pits, in which the production per man per day is large.

TABLE 86.—*Production, value, men employed, days worked, and output per man per day at bituminous coal mines in specified States and counties in 1928*—Continued

County	Net tons					Value		Number of employees					Average number of days worked	Average tons per man per day
								Underground						
	Loaded at mines for shipment	Sold to local trade and used by employees	Used at mines for power and heat	Made into coke at mines	Total quantity	Total	Average per ton	Miners, loaders, and shot firers	Haulage and track	All others	Surface	Total		
NEW MEXICO														
Colfax	1,629,878	13,246	20,225		1,663,349	$5,045,000	$3.03	1,065	162	188	314	1,729	214	4.50
McKinley	723,924	23,112	23,808		770,844	2,526,000	3.28	721	140	92	135	1,088	201	3.53
Rio Arriba	31,003	28	400		31,431	85,000	2.70	27	5	4	4	40	270	2.91
San Juan		7,032			7,032	19,000	2.70	15	3	3	3	24	123	2.39
Other counties (Lincoln, Sandoval, Santa Fe, and Socorro)	219,662	7,077	12,456		239,195	961,000	4.02	314	67	32	147	560	235	1.82
	2,604,467	50,495	56,889		2,711,851	8,636,000	3.18	2,142	377	319	603	3,441	213	3.70
NORTH CAROLINA														
Total	51,740	5,900	3,220		60,860	$201,000	$3.30	160	32	16	32	240	180	1.41
NORTH DAKOTA (LIGNITE)														
Adams	35,633	13,477	1,276		50,386	$91,000	$1.81	47	6	2	10	65	157	4.94
Billings, Golden Valley, and McKenzie	1,500	3,510			5,010	10,000	2.00	15	1	2	3	21	99	2.40
Bowman	27,877	14,039	6,500		48,416	73,000	1.51	31	3	2	17	53	183	5.00
Burke	282,020	11,949			293,969	502,000	1.71				82	82	228	[a] 15.70
Burleigh	209,655	17,629	2,206		229,490	351,000	1.53	142	20	11	31	204	174	6.47
Divide	9,987	7,797			17,784	42,000	2.36	30	2	4	6	42	166	2.55
Dunn		3,330			3,330	8,000	2.40	7	1	1	1	10	133	2.50
Grant	3,263	15,372	200		18,835	40,000	2.12	23	3	3	8	37	136	3.74
Hettinger	8,825	12,114	300		21,239	38,000	1.79	27	3	5	5	40	169	3.14
McLean	53,230	27,352	1,000		81,582	167,000	2.05	45	5	3	60	113	150	4.82
Mercer	415,421	27,168	5,599		448,188	674,000	1.50	197	19	4	65	285	163	9.67
Morton	14,924	28,735			43,659	80,000	1.83	45	3	3	8	59	214	3.45

Mountrail	------------	4,372	------------	------------	4,372	12,000	2.74	9	2	2	3	16	145	1.88
Oliver	------------	4,151	------------	------------	4,151	6,000	1.45	------------	------------	------------	9	9	164	2.81
Stark	19,360	33,664	1,035	------------	54,059	88,000	1.63	51	4	4	13	72	207	3.63
Ward	225,032	37,389	62	------------	262,483	475,000	1.81	68	2	3	70	143	194	9.47
Williams	12,994	49,888	95	------------	62,977	123,000	1.95	66	4	6	8	84	204	3.67
	1,319,721	311,936	18,273	------------	1,649,930	2,780,000	1.68	803	78	55	399	1,335	177	7.00
OHIO														
Athens	947,276	36,661	7,992	------------	991,929	$1,495,000	$1.51	2,077	262	387	359	3,085	98	3.27
Belmont	3,536,845	260,123	27,742	------------	3,824,710	6,051,000	1.58	3,667	373	718	505	5,263	170	4.26
Carroll	285,886	98,185	1,395	------------	385,466	619,000	1.61	320	48	43	45	456	240	3.53
Columbiana	165,070	74,989	1,134	------------	241,193	471,000	1.95	279	42	14	40	375	185	3.48
Coshocton	154,415	56,223	860	------------	211,498	395,000	1.87	208	23	30	27	288	204	3.60
Guernsey	398,730	150,359	5,681	------------	554,770	992,000	1.79	728	99	132	85	1,044	131	4.06
Harrison	2,432,935	17,344	55,451	------------	2,505,730	3,836,000	1.53	622	168	131	606	1,527	223	7.37
Hocking	231,160	77,041	1,133	------------	309,334	519,000	1.68	601	97	70	111	879	96	3.65
Holmes	------------	15,598	------------	------------	15,598	46,000	2.95	31	3	3	3	40	190	2.05
Jackson	80,264	75,974	5,186	------------	161,424	349,000	2.16	233	31	33	34	331	158	3.09
Jefferson	2,064,768	610,217	16,455	------------	2,691,440	4,853,000	1.80	1,780	350	247	540	2,917	210	4.40
Lawrence	70	111,683	------------	------------	111,753	242,000	2.17	138	10	14	15	177	233	2.71
Mahoning	------------	58,324	572	------------	58,896	168,000	2.85	98	8	6	20	132	193	2.32
Medina, Summit, and Wayne	------------	7,040	776	------------	7,816	33,000	4.22	11	2	2	3	18	177	2.45
Meigs	785,090	35,825	570	------------	821,485	1,324,000	1.61	705	79	120	98	1,002	225	3.65
Morgan, Scioto, and Washington	61,451	1,751	------------	------------	63,202	103,000	1.63	146	17	28	20	211	102	2.93
Muskingum	105,740	86,704	33	------------	192,477	372,000	1.93	243	17	25	18	303	188	3.39
Noble	312,305	8,203	7,125	------------	327,633	505,000	1.54	337	62	83	35	517	158	4.01
Perry	453,207	59,194	7,420	------------	519,821	752,000	1.45	403	52	45	156	656	143	5.56
Portage	------------	6,767	300	------------	7,067	20,000	2.83	10	3	2	3	18	129	3.04
Stark	114,352	288,870	2,518	------------	405,740	1,035,000	2.55	377	51	30	66	524	235	3.30
Tuscarawas	587,087	546,689	4,350	------------	1,138,126	2,092,000	1.84	1,009	127	133	163	1,432	198	4.01
Vinton	69,791	22,836	1,490	------------	94,117	167,000	1.77	128	13	21	14	176	132	4.04
	12,786,442	2,706,600	148,183	------------	15,641,225	26,439,000	1.69	14,151	1,937	2,317	2,966	21,371	171	4.28

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[6] The output of this county is obtained from strip pits, in which the production per man per day is large.

TABLE 86.—*Production, value, men employed, days worked, and output per man per day at bituminous coal mines in specified States and counties in 1928*—Continued

OKLAHOMA

County	Net tons					Value		Number of employees					Average number of days worked	Average tons per man per day
								Underground						
	Loaded at mines for shipment	Sold to local trade and used by employees	Used at mines for power and heat	Made into coke at mines	Total quantity	Total	Average per ton	Miners, loaders, and shot firers	Haulage and track	All others	Surface	Total		
Coal	125,549	4,214	1,347		131,110	$420,000	$3.20	137	19	21	21	198	199	3.32
Craig		2,187			2,187	5,000	2.29	13	1	1	1	16	58	2.36
Haskell	146,172	789	1,775		148,736	426,000	2.86	48	17	4	78	147	209	4.85
Latimer	236,725	4,148	6,817		247,690	749,000	3.02	348	48	71	64	531	176	2.64
Le Flore	486,455	73,082	9,341		568,878	1,571,000	2.76	830	113	117	138	1,198	143	3.32
Okmulgee	732,714	1,608	1,000		735,322	1,876,000	2.55	868	157	51	100	1,176	149	4.19
Pittsburg	1,144,563	6,852	23,641		1,175,056	4,041,000	3.44	1,422	295	351	248	2,316	188	2.70
Rogers	68,032	690	2,184		70,906	169,000	2.38				106	106	94	7.12
Tulsa	224,190	13,061	3,151		240,402	665,000	2.77	130	12	15	194	351	165	4.14
Other counties (Mayes, Muskogee, and Wagoner)	178,642	1,708	688		181,038	443,000	2.45				179	179	187	5.41
	3,343,042	108,339	49,944		3,501,325	10,365,000	2.96	3,796	662	631	1,129	6,218	169	3.34

PENNSYLVANIA (BITUMINOUS)

County	Loaded at mines for shipment	Sold to local trade and used by employees	Used at mines for power and heat	Made into coke at mines	Total quantity	Value Total	Value Average per ton	Miners, loaders, and shot firers	Haulage and track	All others	Surface	Total	Average number of days worked	Average tons per man per day
Allegheny	11,261,740	2,059,020	72,774		13,393,534	$24,843,000	$1.85	9,170	1,300	1,053	1,332	12,855	255	4.09
Armstrong	4,763,216	147,944	6,064		4,917,224	8,363,000	1.70	4,114	435	330	651	5,530	184	4.83
Beaver	117,772	150,765	282		268,819	588,000	2.19	180	22	14	80	296	235	3.86
Bedford	429,110	10,833	7,335	66,079	513,357	1,145,000	2.23	641	100	71	79	891	164	3.51
Blair and Fulton	221,230	69,960	5,878	30,306	327,374	726,000	2.22	454	58	45	56	613	246	2.17
Bradford and Lycoming	36,307	4,313			40,620	102,000	2.51	72	5	5	10	92	243	1.82
Butler	1,506,804	97,487	5,064		1,609,355	2,861,000	1.78	1,593	185	155	263	2,196	211	3.47
Cambria	12,314,819	2,430,944	148,841	117,900	15,012,504	31,713,000	2.11	12,424	1,533	1,275	1,805	17,037	204	4.32
Centre	811,800	44,998	3,623		860,421	1,535,000	1.78	1,074	95	77	112	1,358	179	3.54
Clarion	1,072,396	93,268	1,943		1,167,607	2,037,000	1.74	1,488	160	97	193	1,938	173	3.49
Clearfield	3,259,806	143,340	25,462		3,428,608	6,377,000	1.86	4,914	449	454	633	6,450	156	3.41
Clinton	210,999	31,484	3,649		246,132	433,000	1.76	134	25	7	85	251	171	5.73
Elk	814,099	19,309	2,290		835,698	1,502,000	1.80	894	72	54	98	1,118	232	3.22
Fayette	25,480,536	218,198	345,472	3,519,897	29,564,103	58,783,000	1.99	11,899	2,963	4,486	3,086	22,434	251	5.25

Greene	6, 444, 271	35, 491	51, 899	--------	6, 531, 661	12, 223, 000	1. 87	2, 561	573	767	766	4, 667	241	5. 80
Huntingdon	319, 769	6, 685	9, 927	--------	336, 381	789, 000	2. 35	715	93	40	97	945	173	2. 06
Indiana	7, 914, 642	256, 799	29, 268	280, 558	8, 481, 267	15, 644, 000	1. 84	7, 213	738	603	1, 094	9, 648	186	4. 72
Jefferson	2, 200, 495	40, 033	12, 226	--------	2, 252, 755	3, 884, 000	1. 72	2, 388	240	225	340	3, 193	172	4. 11
Lawrence	172, 350	32, 395	13, 082	--------	217, 827	624, 000	2. 86	188	41	25	33	287	277	2. 74
McKean and Venango	4, 391	6, 157	--------	--------	10, 548	27, 000	2. 56	21	3	2	7	33	271	1. 18
Mercer	260, 979	9, 893	11, 638	--------	282, 510	738, 000	2. 61	208	44	40	43	335	279	3. 02
Somerset	9, 069, 459	112, 730	106, 142	--------	9, 288, 331	17, 035, 000	1. 83	7, 202	1, 029	887	1, 244	10, 362	202	4. 43
Tioga	55, 430	50, 615	4, 179	--------	110, 224	358, 000	3. 25	306	32	19	57	414	91	2. 93
Washington	14, 373, 082	282, 925	92, 514	27, 748	14, 776, 269	26, 740, 000	1. 81	10, 598	1, 639	1, 470	1, 782	15, 489	244	3. 91
Westmoreland	14, 669, 539	700, 402	251, 717	1, 107, 376	16, 729, 034	30, 825, 000	1. 84	9, 585	1, 754	1, 528	2, 115	14, 982	210	5. 31
	117, 785, 042	7, 055, 988	1, 211, 269	5, 149, 864	131, 202, 163	249, 895, 000	1. 90	90, 036	13, 588	13, 729	16, 061	133, 414	218	4. 52

SOUTH DAKOTA (LIGNITE)

Corson and Harding	--------	700	--------	--------	700	$2, 000	$2. 86	4	--------	--------	--------	4	110	1. 59
Dewey	663	6, 200	--------	--------	6, 863	18, 000	2. 62	13	--------	--------	--------	13	140	3. 76
Meade and Ziebach	--------	1, 690	--------	--------	1, 690	7, 000	4. 14	8	--------	--------	--------	8	104	2. 04
Perkins	--------	4, 676	--------	--------	4, 676	12, 000	2. 57	16	--------	--------	--------	16	134	2. 19
	663	13, 266	--------	--------	13, 929	39, 000	2. 80	41	--------	--------	--------	41	128	2. 66

TENNESSEE

Anderson	947, 576	12, 409	3, 420	--------	963, 405	$1, 561, 000	$1. 62	770	124	107	142	1, 143	227	3. 72
Campbell	1, 036, 913	25, 438	4, 920	--------	1, 067, 271	1, 967, 000	1. 84	1, 088	165	139	212	1, 604	223	2. 99
Claiborne	977, 334	7, 931	--------	--------	985, 265	1, 746, 000	1. 77	717	160	148	144	1, 169	233	3. 61
Fentress	465, 755	4, 189	12, 990	--------	482, 934	701, 000	1. 45	264	60	47	95	466	250	4. 14
Grundy	405, 311	2, 930	5, 330	29, 107	442, 678	790, 000	1. 78	418	63	44	103	628	201	3. 50
Hamilton	153, 223	7, 801	2, 108	--------	163, 132	384, 000	2. 35	200	47	37	71	355	224	2. 05
Marion	190, 251	5, 537	3, 747	--------	199, 535	391, 000	1. 96	322	40	28	86	476	139	3. 02
Morgan	273, 430	7, 104	9, 949	30, 755	321, 238	504, 000	1. 57	447	101	115	92	755	246	1. 73
Scott	102, 724	1, 748	5, 020	--------	109, 492	144, 000	1. 32	103	19	20	42	184	132	4. 50
Other counties (Cumberland, Overton, Putnam, Rhea, Roane, Sequatchie, and White)	726, 706	16, 793	18, 716	113, 794	876, 009	1, 506, 000	1. 72	622	151	133	163	1, 069	267	3. 07
	5, 279, 223	91, 880	66, 200	173, 656	5, 610, 959	9, 694, 000	1. 73	4, 951	930	818	1, 150	7, 849	226	3. 16

Table 86.—*Production, value, men employed days worked, and output per man per day at bituminous coal mines in specified States and counties in 1928*—Continued

County	Net tons					Value		Number of employees					Average number of days worked	Average tons per man per day
								Underground						
	Loaded at mines for shipment	Sold to local trade and used by employees	Used at mines for power and heat	Made into coke at mines	Total quantity	Total	Average per ton	Miners, loaders, and shot firers	Haulage and track	All others	Surface	Total		
TEXAS														
Bituminous: Palo Pinto, Webb, and Wise	112, 736	2, 157	2, 956	----------	117, 849	$377, 000	$3. 20	389	58	50	92	589	200	1. 00
Lignite: Anderson, Bastrop, Bexar, Henderson, Houston, Leon, Medina, Milam, Nacogdoches, Titus, and Wood	1, 028, 634	18, 930	16, 621	----------	1, 064, 185	1, 212, 000	1. 14	585	103	63	122	873	204	5. 96
	1, 141, 370	21, 087	19, 577	----------	1, 182, 034	1, 589, 000	1. 34	974	161	113	214	1, 462	203	3. 99
UTAH														
Carbon	4, 157, 178	35, 148	19, 663	49, 113	4, 261, 102	$10, 791, 000	$2. 53	1, 759	372	270	472	2, 873	193	7. 67
Emery and Grand	506, 002	6, 033	5, 923	----------	517, 958	1, 302, 000	2. 51	252	28	41	55	376	167	8. 24
Summit	50, 228	2, 439	837	----------	53, 504	121, 000	2. 26	35	13	9	9	66	216	3. 75
Uintah	----------	7, 378	106	----------	7, 484	31, 000	4. 14	18	3	2	4	27	219	1. 26
Other counties (Iron and San Pete)	----------	2, 491	5	----------	2, 496	8, 000	3. 21	7	1	1	1	10	88	2. 85
	4, 713, 408	53, 489	26, 534	49, 113	4, 842, 544	12, 253, 000	2. 53	2, 071	417	323	541	3, 352	191	[7] 7. 57
VIRGINIA														
Dickenson	785, 202	9, 064	1, 740	----------	796, 006	$1, 152, 000	$1. 45	410	139	157	133	839	213	4. 46
Lee	2, 178, 748	19, 032	2, 372	----------	2, 200, 152	3, 738, 000	1. 70	1, 060	251	362	291	1, 964	252	4. 45
Montgomery	98, 198	4, 364	974	----------	103, 536	298, 000	2. 88	260	25	11	68	364	120	2. 36
Russell	1, 240, 462	17, 106	2, 518	----------	1, 260, 086	1, 857, 000	1. 47	735	237	195	234	1, 401	193	4. 66
Tazewell	2, 391, 451	13, 321	5, 719	----------	2, 410, 491	4, 523, 000	1. 88	1, 022	251	430	387	2, 090	251	4. 59
Wise	4, 614, 971	45, 606	23, 167	378, 158	5, 061, 902	8, 627, 000	1. 70	2, 707	829	1, 276	650	5, 462	227	4. 08
Other counties (Pulaski and Scott)	62, 760	3, 360	2, 640	----------	68, 760	180, 000	2. 62	99	34	14	45	192	140	2. 56
	11, 371, 792	111, 853	39, 130	378, 158	11, 900, 933	20, 375, 000	1. 71	6, 293	1, 766	2, 445	1, 808	12, 312	226	4. 28

WASHINGTON

King	489, 905	51, 436	222	----------	541, 563	$1, 787, 000	$3. 30	448	75	129	138	790	234	2. 93
Kittitas	1, 037, 298	19, 771	19, 529	----------	1, 076, 598	3, 767, 000	3. 50	909	98	77	165	1, 249	201	4. 29
Lewis	49, 197	18, 726	1, 710	----------	69, 633	167, 000	2. 40	82	12	3	29	126	147	3. 76
Pierce	246, 442	5, 393	3, 100	29, 353	284, 288	1, 209, 000	4. 25	208	48	139	79	474	250	2. 39
Other counties (Cowlitz, Thurston, and Whatcom)	517, 079	21, 571	9, 169	----------	547, 819	1, 790, 000	3. 27	304	51	19	86	460	234	5. 10
	2, 339, 921	116, 897	33, 730	29, 353	2, 519, 901	8, 720, 000	3. 46	1, 951	284	367	497	3, 099	220	3. 70

WEST VIRGINIA

Barbour	2, 520, 571	21, 355	3, 588	----------	2, 545, 514	$3, 350, 000	$1. 32	1, 649	244	286	233	2, 412	195	5. 43
Boone	3, 431, 739	20, 881	7, 141	----------	3, 459, 761	5, 439, 000	1. 57	1, 677	436	401	424	2, 938	219	5. 37
Braxton	210, 589	2, 448	----------	----------	213, 037	322, 000	1. 51	108	38	39	29	214	229	4. 34
Brooke	1, 288, 870	824, 647	----------	----------	2, 113, 517	3, 748, 000	1. 77	1, 085	245	192	155	1, 677	224	5. 64
Clay	915, 642	22, 792	13, 250	----------	951, 684	1, 498, 000	1. 57	386	126	48	150	710	242	5. 54
Fayette	12, 011, 247	140, 476	46, 033	418, 655	12, 616, 411	22, 848, 000	1. 81	7, 437	1, 924	1, 603	1, 713	12, 677	235	4. 23
Gilmer	107, 002	2, 800	5, 270	----------	115, 072	148, 000	1. 29	83	30	5	28	146	226	3. 49
Greenbrier	1, 653, 349	27, 097	7, 274	----------	1, 687, 720	2, 551, 000	1. 51	774	285	117	166	1, 342	236	5. 34
Hancock	----------	27, 899	40	----------	27, 939	68, 000	2. 43	30	2	3	3	38	181	4. 05
Harrison	6, 749, 460	302, 074	1, 299	----------	7, 052, 833	9, 351, 000	1. 33	4, 062	862	699	721	6, 344	179	6. 20
Kanawha	6, 623, 047	74, 634	27, 133	----------	6, 724, 814	10, 283, 000	1. 53	4, 146	938	716	709	6, 509	202	5. 11
Lincoln	216, 296	1, 694	1, 320	----------	219, 310	272, 000	1. 24	182	46	36	36	300	175	4. 17
Logan	18, 707, 071	104, 249	10, 885	----------	18, 822, 205	26, 859, 000	1. 43	7, 091	1, 967	1, 679	1, 824	12, 561	227	6. 60
McDowell	21, 215, 070	166, 450	133, 440	144, 503	21, 659, 463	38, 333, 000	1. 77	8, 832	2, 652	3, 515	3, 409	18, 408	219	5. 36
Marion	8, 533, 557	173, 888	62, 645	----------	8, 770, 090	13, 475, 000	1. 54	3, 614	842	1, 031	705	6, 192	231	6. 14
Marshall	2, 174, 203	330, 076	18, 252	----------	2, 522, 531	4, 084, 000	1. 62	1, 466	214	240	253	2, 173	253	4. 59
Mason	19, 056	29, 656	1, 975	----------	50, 687	98, 000	1. 93	50	8	5	5	68	205	3. 63
Mercer	3, 708, 810	31, 265	5, 900	19, 727	3, 765, 702	6, 525, 000	1. 73	1, 799	610	326	808	3, 543	236	4. 50
Mineral	288, 925	8, 989	868	----------	298, 782	530, 000	1. 77	371	44	33	71	519	191	3. 01
Mingo	5, 238, 871	37, 134	6, 298	----------	5, 282, 303	7, 808, 000	1. 48	2, 100	753	663	790	4, 306	225	5. 45
Monongalia	7, 936, 242	158, 240	309	----------	8, 094, 791	10, 190, 000	1. 26	3, 877	873	448	608	5, 806	219	6. 37
Nicholas	104, 432	3, 433	5, 044	----------	112, 909	266, 000	2. 36	130	39	11	33	213	156	3. 39
Ohio	2, 277, 586	263, 425	6, 626	----------	2, 547, 637	4, 055, 000	1. 59	1, 756	294	138	148	2, 336	258	4. 23
Preston	1, 745, 119	19, 580	12, 839	139, 746	1, 917, 284	3, 133, 000	1. 63	1, 522	300	169	257	2, 248	167	5. 10
Putnam	426, 945	2, 205	----------	----------	429, 150	670, 000	1. 56	345	78	75	79	577	254	2. 93
Raleigh	15, 365, 009	120, 841	78, 978	----------	15, 564, 828	27, 129, 000	1. 74	6, 105	1, 867	2, 109	1, 779	11, 860	257	5. 11
Randolph	449, 129	12, 535	1, 530	----------	463, 194	636, 000	1. 37	367	80	43	85	575	133	6. 04
Taylor	941, 016	18, 595	----------	----------	959, 611	1, 263, 000	1. 32	807	160	68	131	1, 166	152	5. 41
Tucker	843, 329	6, 034	49, 807	1, 394	900, 564	1, 721, 000	1. 91	671	125	95	95	986	170	5. 39
Upshur	599, 805	12, 002	8, 230	----------	620, 037	762, 000	1. 23	450	47	74	82	653	189	5. 02
Webster	33, 620	23, 053	605	----------	57, 278	161, 000	2. 81	59	11	5	9	84	230	2. 96
Wyoming	2, 020, 348	18, 626	11, 977	----------	2, 050, 951	3, 459, 000	1. 69	813	407	294	286	1, 800	220	5. 17
Other counties (Grant, Lewis, and Wayne)	315, 109	10, 954	8, 487	----------	334, 550	445, 000	1. 33	201	42	31	78	352	231	4. 11
	128, 671, 064	3, 020, 027	537, 043	724, 025	132, 952, 159	211, 480, 000	1. 59	64, 045	16, 589	15, 197	15, 902	111, 733	223	5. 35

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[7] The calculated output per man per day in Utah is affected by the practice of men going into certain mines to shoot and load coal on days when the tipples and mines as a whole are not in operation.

TABLE 86.—*Production, value, men employed, days worked, and output per man per day at bituminous coal mines in specified States and counties in 1928*—Continued

WYOMING

County	Net tons					Value		Number of employees					Average number of days worked	Average tons per man per day
	Loaded at mines for shipment	Sold to local trade and used by employees	Used at mines for power and heat	Made into coke at mines	Total quantity	Total	Average per ton	Underground			Surface	Total		
								Miners, loaders, and shot firers	Haulage and track	All others				
Big Horn and Park	----------	2,861	----------	----------	2,861	$13,000	$4.54	5	1	1	1	8	253	1.41
Campbell, Converse, Johnson, and Weston	72,898	18,780	9,955	----------	101,633	163,000	1.60	50	11	15	58	134	124	6.09
Carbon	492,601	9,674	16,700	----------	518,975	1,410,000	2.72	153	29	38	63	283	210	[8] 8.72
Fremont	79,803	2,694	6,203	----------	88,700	203,000	2.29	67	10	6	14	97	144	6.36
Hot Springs	464,432	9,067	35,702	----------	509,201	1,690,000	3.32	377	92	71	73	613	196	4.24
Lincoln	1,065,839	9,894	48,883	----------	1,124,616	3,138,000	2.79	585	90	99	157	931	242	5.15
Sheridan	734,300	41,291	2,030	----------	777,621	1,607,000	2.07	222	74	10	89	395	153	[8] 12.89
Sweetwater	3,345,313	26,165	55,985	----------	3,427,463	9,078,000	2.65	1,441	377	191	355	2,364	229	6.33
Teton and Uinta	9,744	10,269	600	----------	20,613	61,000	2.96	12	2	1	3	18	216	5.31
	6,264,930	130,695	176,058	----------	6,571,683	17,363,000	2.64	2,912	686	432	813	4,843	214	6.34

[8] The large output per man is explained by the use of loading machines.

COAL PRODUCED AND CONSUMED IN ALASKA

TABLE 87.—*Coal produced and consumed in Alaska, 1919–1928*

Year	Produced in Alaska, chiefly subbituminous and lignite [1]		Imported from States, chiefly bituminous coal from Washington [2] (net tons)	Imported from foreign countries, chiefly bituminous coal from British Columbia [2] (net tons)	Total coal consumed (net tons)
	Net tons	Value			
1919	60, 894	$345, 617	57, 166	48, 708	166, 768
1920	61, 111	355, 668	38, 128	45, 264	144, 503
1921	76, 817	496, 394	24, 278	33, 776	134, 871
1922	79, 275	430, 639	28, 457	34, 251	141, 983
1923	119, 826	755, 469	34, 082	43, 205	197, 113
1924	99, 663	559, 980	40, 161	41, 980	181, 804
1925	82, 868	404, 617	37, 324	57, 230	177, 422
1926	87, 300	459, 000	35, 620	34, 254	157, 174
1927	104, 300	548, 000	39, 443	30, 492	174, 235
1928	126, 100	662, 000	39, 184	32, 584	197, 868

[1] Compiled by the Alaska branch of the U. S. Geological Survey.
[2] Compiled from records of the Bureau of Foreign and Domestic Commerce.

DETAILED STATISTICS OF HARD-COAL INDUSTRY OUTSIDE OF PENNSYLVANIA

Need of separate figures.—To most people, including those familiar with the coal trade, the term "anthracite" ordinarily denotes hard coal produced in the northeastern counties of Pennsylvania. The relatively large production from this familiar area plus a long-standing and deserved popularity of Pennsylvania anthracite with millions of consumers over a wide market largely explains the common practice of identifying anthracite as hard coal produced in Pennsylvania. Even some close observers of the coal industry are not generally aware that a considerable tonnage of coal of anthracite and semianthracitic qualities is produced outside of Pennsylvania and that the volume of this production has been steadily increasing.

In this discussion the ranks given coals under the system of classification adopted by the United States Geological Survey a number of years ago are taken as guides. According to the method employed by the Survey anthracite is defined as "hard coal having a fuel ratio (fixed carbon divided by the volatile matter) of not more than 50 or 60 and not less than 10," while the fuel ratio for semianthracite (with some modifications) ranges from 6 to 10. Since this discussion covers the commercial production of coals outside of Pennsylvania, which range in fuel ratios from 6.3 to 39.1, it includes those classified either as anthracite or semianthracite by the United States Geological Survey. Such coals are commercially produced in the Crested Butte field of Colorado, the Los Cerrillos field of New Mexico, the Spadra and Russellville districts of Arkansas, and that portion of the Valley Coal Fields of Virginia lying in Montgomery and Pulaski Counties.[37]

On the pages indicated, Mr. Campbell, geologist of the United States Geological Survey, classifies the Spadra and Russellville coals as semianthracites and some of the Cerrillos and Crested Butte coals as anthracites. In a later report (Campbell, Marius R., and others, The Valley Coal Fields of Virginia: Virginia Geol. Survey Bull. 25, prepared in cooperation with the United States Geological Survey, Charlottesville, Va., 1925, pp. 115, 126), the coals in Montgomery and Pulaski Counties, lying in the Valley Fields of Virginia, are ranked as semianthracites.

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[37] Campbell, Marius R., and others, The Coal Fields of the United States: U. S. Geol. Survey Prof. Paper 100–A, 1922, pp. 27–28, 30.

In this report only the output of anthracite or semianthracite is considered in those fields—such as Los Cerrillos, Crested Butte, and the Valley Fields—where other coals of higher volatile content are also obtained.

It should also be noted that seams of anthracite and semianthracite, of greatly varying qualities and not at present in commercial production, are found in the Yampa field of Colorado, in Iron and Kane Counties, Utah, in Whatcom County and in the Fairfax district of Washington, and possibly in some other areas for which information is not available. In addition, graphitic anthracite is found in the Portsmouth district of Rhode Island and in the Fall River area of Massachusetts.

Wherever the products from the leading coal fields outside of Pennsylvania enter the fuel markets they are generally known by characteristic trade designations. Thus, the Virginia coal is sold under the trade name of "Great Valley (or Virginia) anthracite," the Arkansas coal as "Arkansas anthracite," and the hard coals from Colorado and New Mexico as "Colorado anthracite" and "New Mexico (or Cerrillos) anthracite," respectively. For convenience, these trade designations are used in this report, and wherever a comparison is made between Pennsylvania anthracite and the combined hard-coal industry outside of Pennsylvania (as in the graphs and tables) the latter is frequently referred to under the caption, "Other hard coal."

No attempt is made here to set up or lend authority to a particular system of classifying coals. Such procedure would be especially inappropriate at present: First, because the task of classifying coals is lengthy and complicated, and the results of many years work by the United States Geological Survey in this special field are available; and, second, a number of questions that have been raised regarding the usefulness of various coal-classification schemes are now being considered by the sectional committee on classification of coal, under the sponsorship of the American Society for Testing Materials and the rules of the American Standards Association. The sectional committee has been divided into three technical committees on scientific classification, use classification, and marketing practice. The three technical committees in turn are also divided into subcommittees. Suffice it to say that a slightly higher volatile content (or a slightly lower fuel ratio) does not necessarily impair the market value of a coal. On the contrary, the Lykens Valley coals of Pennsylvania, which have from approximately 2 to 5 per cent more volatile content than most Pennsylvania anthracites, have long been recognized in the trade as possessing some excellent qualities that make the consumer willing to pay a premium for them over and above the price obtained for the usual Pennsylvania anthracite.

TABLE 88.—*Production and average value per ton of hard coal mined outside of Pennsylvania, 1913–1928*

Year	Production (net tons)			Average value per ton		
	Virginia	Arkansas, Colorado, and New Mexico	Total	Virginia	Arkansas, Colorado, and New Mexico	Total
1913	54,579	308,745	363,324	$1.54	$2.76	$2.58
1914	45,151	300,927	346,078	1.98	2.50	2.43
1915	51,141	325,255	376,396	2.16	2.95	2.84
1916	109,543	415,699	525,242	1.69	2.78	2.55
1917	127,836	446,337	574,173	2.71	3.73	3.50
1918	127,448	441,556	569,004	3.21	5.13	4.70
1919	105,753	372,258	478,011	3.11	5.42	4.91
1920	163,728	424,403	588,131	3.88	6.06	5.45
1921	85,161	[1] 329,184	[1] 414,345	4.08	5.75	5.40
1922	114,111	208,314	322,425	4.49	6.44	5.75
1923	213,659	412,021	625,680	4.82	5.61	5.34
1924	186,084	518,429	704,513	3.68	5.06	4.70
1925	266,657	519,937	786,594	3.75	4.75	4.41
1926	263,823	579,302	843,125	4.07	4.80	4.57
1927	158,828	493,041	651,869	2.83	4.99	4.46
1928	171,896	540,510	712,406	2.78	4.64	4.19

[1] Includes a small tonnage of bituminous coal from a different seam for one mine in Colorado.

Total annual production.—From 363,324 net tons in 1913 the production of hard coal outside of Pennsylvania practically doubled in the 16 years through 1928. Although output showed large gains beginning in 1916 and extending through the war period, further expansion occurred during the postwar years—an indication of the stable character of the new demand. In 1922, which was an exception to the general trend, tonnage was reduced because of the same labor difficulties that seriously curtailed production throughout the bituminous-coal industry. Maximum records of 786,594 and 843,125 net tons were attained in 1925 and 1926, respectively, when the demand for high-grade household fuels was stimulated by the long labor suspension in the Pennsylvania anthracite fields. (See Table 88.) The production of 712,406 tons in 1928 represented a gain of 9.3 per cent over 1927 when, partly because of the generally depressed character of the coal market and partly because of labor difficulties in some of the fields, output receded somewhat from the high level maintained in the two preceding years. This record of gradual growth over an extended period is especially significant when it is compared with other branches of the coal industry that have either lost volume or barely remained stationary since 1913.

TABLE 89.—*Relative rates of growth of bituminous coal, Pennsylvania anthracite, and all other hard coal, 1913–1928*

[The figures for the year 1913 are represented by the number 100, and the figures for all other years are expressed as percentages of the 1913 rate]

Year	Bituminous coal	Pennsylvania anthracite	All other anthracite and semianthracite
1913	100	100	100
1914	88	99	95
1915	93	97	104
1916	105	96	145
1917	115	109	158
1918	121	108	157
1919	97	96	132
1920	119	98	162
1921	87	99	114
1922	88	60	89
1923	118	102	172
1924	101	96	194
1925	109	68	217
1926	120	92	232
1927	108	88	179
1928	105	82	196

To make comparisons easier, the figures of production are reduced to index numbers in Table 89, taking the year 1913 as 100. It will be seen that the output of Pennsylvania anthracite was 18 per cent less in 1928 than in 1913 and that over the same period the production of bituminous coal increased only 5 per cent. The production of all other hard coal outside of Pennsylvania, on the contrary, increased 96 per cent; and if the years 1925 and 1926 are taken the increases are 117 and 132 per cent, respectively. In only two periods—1914 and 1922—has production gone below the 1913 level; and in 1922 the disturbing factor was labor difficulties, as previously noted. As shown in Figure 25, which graphically depicts the 16-year period, bituminous coal has only slightly more than held its own, Pennsylvania anthracite has fallen off notably, while all other hard coal has greatly improved its relative position as a factor in the coal supply.

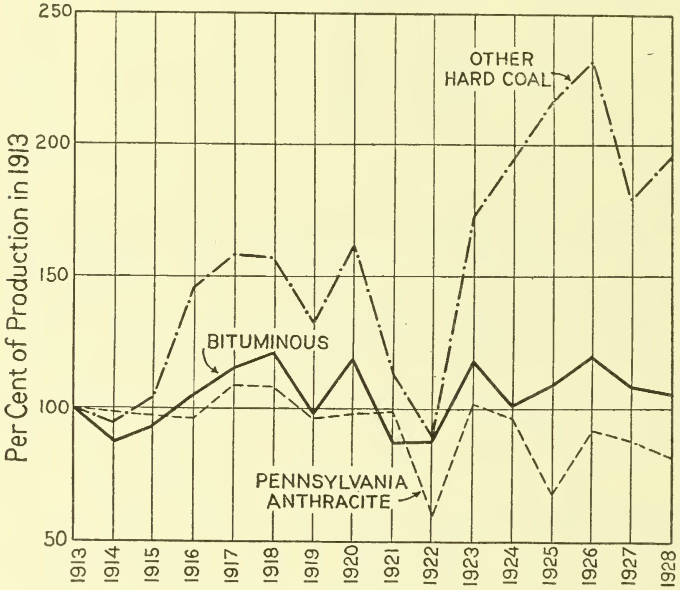

FIGURE 25.—Relative rates of growth of bituminous coal, Pennsylvania anthracite, and other hard coals in the United States, 1913–1928. Production data for 1913 are represented by the number 100, and the figures for all other years are expressed as percentages of the 1913 rate

Average value per net ton.—The relative increase in the production of other hard coal is correlated with a large increase in the average value per net ton received at the mine. For example, the $4.19 per ton obtained in 1928 represents a gain of approximately 62 per cent over the $2.58 for 1913. In general, values reached their highest levels from 1919 to 1923, with averages ranging from $4.91 to $5.75. The years 1924 to 1928, with average values from $4.19 to $4.70, marked a recession in prices, partly due to the nation-wide depression in the coal market. The effect of this price recession, however, was partly offset by the increased production in the later years. For example, the maximum average value of $5.75 per ton in 1922 was obtained on a tonnage equivalent to only 45 per cent of the 1928 output, and the 1921 average of $5.40 was realized on 414,345 tons—less than one-half of the 1926 production.

In contrast to the downward trend of average realizations on bituminous coal since 1920 the average values of all other hard coal mined outside of Pennsylvania, while tending downward since 1922, have remained more in accord with the higher prices obtained for Pennsylvania anthracite. (See fig. 26.) Considering only average values it is clear that all other hard coal has suffered relatively less from the depressed character of the coal market since 1923 than has bituminous coal. For example, the 1928 average value of all other hard coal represented a decline of 27 per cent from the peak of 1922, whereas the 1928 average value of bituminous coal represented a drop of 50 per cent from the maximum average of 1920. In general, the factors influencing the values of bituminous coal seem to have a distant and much less potent effect on the average values of other hard coal, with some periods (such as 1915 and 1916) showing opposing trends in the value curves. Since 1921 a fairly constant differential of more than $2 has been maintained between the two fuels.

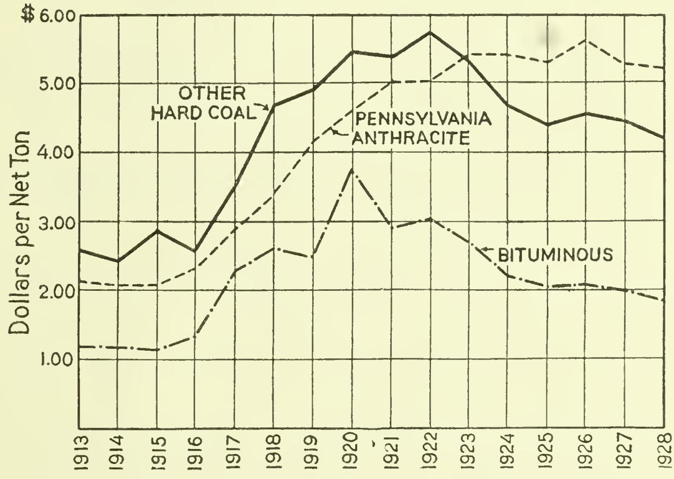

FIGURE 26.—Trends in the average value per net ton f. o. b. mines of bituminous coal, Pennsylvania anthracite, and other hard coal mined outside of Pennsylvania, 1913–1928. Data on average values include all sizes, screenings, mine-run, and steam grades, as well as prepared sizes. Also for purposes of comparability the average values of Pennsylvania anthracite have been converted from a gross to a net ton basis

In connection with the higher sales realization on other hard coal in comparison with bituminous it should be remembered that the former is produced under more difficult conditions of mining than those prevailing in any of the large bituminous fields. The very processes of nature that brought about devolatilization of the coal resulted in a folding and faulting of the seams which make them more difficult to mine; hence, operations cost more than in favorably situated bituminous workings. The physical handicaps of mining in the other hard-coal fields are reflected in the average daily production per man, which in 1928 was less than one-half the average daily output per worker in the bituminous industry.

Unless otherwise indicated, the figures on value used in this report are those obtained by the Bureau of Mines in connection with its annual canvass of coal operations. In replying to the bureau's questionnaire the operators are instructed that: "Value reported should be total dollars received for product f. o. b. cars at mine less selling expense. Value of coal not sold but used by producer, also mine fuel and *coal* coked (*not coke*), should be estimated at average prices that might have been received and included in total value above." Hence the total value, as shown in Table 90, is the total amount received at the mines f. o. b. cars minus the selling expense, and the average value per ton (Tables 88 and 90) is the average amount received obtained by dividing the total value by the number of tons sold or produced.

Throughout the 16 years under consideration the average values obtained for other hard coal have been within reasonable distance of those received for Pennsylvania anthracite, as shown in Figure 26. For the first 10 years, through 1922, the curve showing the average values of the former is the higher, representing a differential ranging from a few cents to about $1. Beginning with 1923 the position of the curves is reversed, and since that year the curve for Pennsylvania anthracite has been the higher. It should be noted that these average values include all sizes—screenings, mine-run, and other steam grades as well as prepared sizes. Also, for purposes of comparison, the average values of Pennsylvania anthracite have been converted from a gross to a net ton basis.

In comparing sales realizations of Pennsylvania anthracite with those obtained for hard coal mined outside of Pennsylvania, differences in cost of production are an important consideration. During the past five years the labor cost, which accounts for about 70 per cent of the cost of coal,[38] has been generally higher in the Pennsylvania region than in the other hard-coal fields. In the former area the union miners received a 10 per cent increase in wages in September, 1923, and the scale thus established was continued until 1930 by an agreement signed in 1926. In contrast to the fixed scale thus maintained in Pennsylvania during the past five years, wages in the other hard-coal fields have followed the course of wages of bituminous coal miners in the respective States. In general, the tendency has been toward reduction, particularly since 1926. At present all of the hard-coal operations outside of Pennsylvania are nonunion. Hence, it may be said that since 1923 the wage item in the cost of producing all other hard coal possessed a greater potential resiliency than the wage item entering into the cost of Pennsylvania anthracite. Consequently, the average values of the former, which closely represent costs, reacted in greater degree to the general weakness of the coal market from 1924 to 1928. Yet, during two of these years, in 1925 and 1926, the hard-coal industry outside of Pennsylvania enjoyed its largest total income because the recession in prices was more than offset by increased production encouraged by the effects of the British strike and the suspension in the Pennsylvania anthracite fields.

Any similarity in average values that may have prevailed between Pennsylvania anthracite and all other hard coal was due to a general willingness of consumers to pay premiums for superior household fuels wherever they were available rather than to any connection between the two branches of the coal industry. In no way are the operators in the close-knit anthracite industry of Pennsylvania connected with the hard-coal producers outside of that State. On the contrary, the latter are affiliated most closely with the bituminous industry in their respective States regarding railroad connections, marketing problems, labor relations, and even in ownership and operation.

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[38] U. S. Coal Commission Report, Pt. I, 1925, p. 7.

Four separate producing areas.—In addition, because the commercial developments are widely scattered and because of differences in operating and marketing problems among the four principal areas, there is no recognizable unity or community of interests in the hard-coal industry outside of Pennsylvania. Operators in any one of the districts may experience prosperity or depression, owing to conditions that may only distantly affect producers in the other three areas. While it is true that all of the districts shared in the growth of demand for high-quality domestic fuels, the relative proportion of gain for each district has varied. For example, between 1913 and 1928, the production of "Virginia anthracite" increased 215 per cent, "Arkansas anthracite" 72 per cent, and "Colorado anthracite" 45 per cent. It should be noted that the relative increases in production do not adequately indicate the tonnages involved. The increase of 72 per cent for Arkansas represented twice as much actual tonnage as the combined gain for New Mexico and Colorado; and in 1928 Virginia and Arkansas produced more than 75 per cent of the output.

Over the same period average values per net ton for these coals increased 81 per cent, 75 per cent, and 43 per cent, respectively. "New Mexico anthracite" also showed increases in output and value of product. The considerable variations in the degree of growth among the various regions, however, indicate that the trends of production and prices in a given district have been principally affected by the operating conditions prevalent therein and by the distinctive competitive environment with which the operators in the specific area have had to contend. Hence, so far as possible, it is worth while to study in detail the statistical record for each district separately.

Unfortunately, data are not available that will allow for a complete differentiation of figures for each of the four districts. A useful analysis, however, can be made by separating the available statistics into two main divisions: The eastern region, which consists of the operations in Virginia; and the western region, which includes operations in Arkansas, Colorado, and New Mexico. With regard to this latter group, a more useful separation would place Arkansas in one division, and both Colorado and New Mexico in another. Data necessary to make an analysis on this basis, however, are not available. A separation into two main divisions has been made in Tables 88 and 90.

Hard-coal industry of Virginia.—Of the two regions thus defined, Virginia has shown the greater proportionate gain in production. The output of 171,896 net tons of "Great Valley anthracite" in 1928 was over three times that of 1913, and the maximum production in 1925 was almost five times the 1913 tonnage. As shown in Table 88, activity reached its lowest level in 1914 and 1915; but with higher prices and increased demand marking the war years both average values and tonnage improved greatly. In discussing these changes Marius Campbell has indicated that a combination of circumstances placed the Great Valley coal at a disadvantage in the available market during the pre-war years:

> Thus with the best Pocahontas and New River coals selling for less than one dollar per ton at the mines, as they did for many years prior to 1917, it was practically impossible to market the Valley coals for power purposes, and similarly with Pennsylvania anthracite, at not to exceed $2.50 per ton at the mine; it was difficult, if not impossible, for the Valley coals to hold their own in the domestic market.
>
> The World War, with the resulting high price of "smokeless" coal and of anthracite, completely changed these conditions and has seemingly made it possible for operators in the Valley fields with moderate capital to compete in both the steam and domestic markets with the output of the great organizations in other regions. Since the war, * * * conditions in the coal trade continue to be favorable to the introduction of a fuel that is primarily a domestic coal but that in a small way would also be a competitor of the steam coals of the country. Whether or not these conditions will continue * * * can be told only by actual trial.[39]

After the war period production continued to expand through 1926, except in the abnormal years 1921 and 1922. Responding to a demand created by the shortage of Pennsylvania anthracite, 1925 and 1926 were banner years for the Virginia field. When, however, abundant supplies of the Pennsylvania product were again available in 1927 a severe reaction set in, and in comparison with 1926 declines of 39.8 per cent in output and 30.5 per cent in average value per ton are noted. Production recovered somewhat in 1928, but the average sales realization was the lowest for any year since 1917.

The changes in both production and value from 1924 to 1928 emphasize how sensitive the market for "Virginia anthracite" is to the status of competitive fuels. Under normal conditions competition from Pennsylvania anthracite and West Virginia low-volatile coals is encountered wherever the Virginia operator seeks to find an outlet for his domestic grades. Moreover, in the urban communities of easiest access, which are in the Middle Atlantic States, the use of Pennsylvania anthracite by householders is virtually a custom. In the struggle to gain an entree to consumers' bins it has been necessary to offer the Virginia coal at prices considerably below those current for the Pennsylvania product, and the result of this constant pressure upon prices is reflected in the curve shown in Figure 27. During the 16 years under consideration a ton of "Great Valley anthracite" has always brought less than a ton of hard coal produced in the western region, which is comparatively free from the competition of Pennsylvania and West Virginia. At times, as in 1919, 1920, and 1927, the differential between the average values of eastern and western hard coals produced outside of Pennsylvania has exceeded $2 per ton.

Despite a sharply competitive environment the increased production in recent years shows that "Virginia anthracite" has been growing in favor among householders who are interested in a high-grade domestic fuel that can be obtained at a price somewhat less than that obtaining for Pennsylvania anthracite; and at present it enjoys a fairly wide distribution. According to data furnished by an official of the Anthracite Coal Operators' Association of Virginia, the principal market is in the Eastern States, with some shipments to the South and an occasional tonnage moving to Canada and the North Central West. In addition, almost 7 per cent of the 1928 production of "Virginia anthracite" was used as a raw material by briquetting plants in southern Virginia.

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[39] Campbell, Marius R., and others, Work cited, p. 2.

Hard-coal industry in Western States.—Although the western region—which comprises the previously noted coal fields in Arkansas, Colorado, and New Mexico (listed in the order of their production as maintained in 12 of the 16 years)—has not shown the same proportion of increased tonnage since 1913 as Virginia it is the larger producer, and output during the past three years has been more than twice the eastern production. In general, the steady growth in the western region from 1913 to 1928 without abnormally abrupt fluctuations in either output or values (except in years of major labor difficulties) reflects certain responses to the larger considerations of supply and demand characterizing the market for high-grade household fuels in the Middle West. The fact that the level of production and prices has been so maintained is partly explained by the protection in marketing that distance from eastern competition gives the operators in the West.

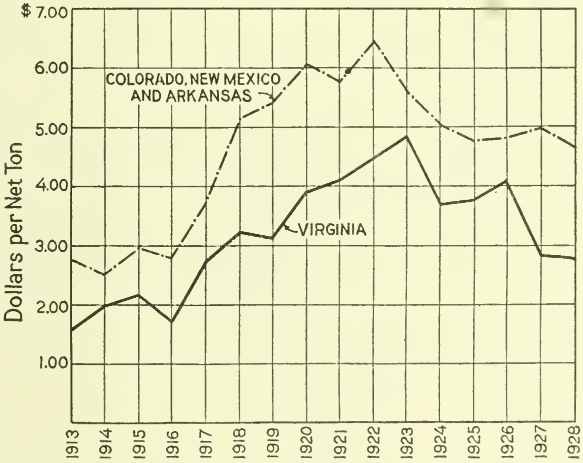

FIGURE 27.—Average values of hard coal mined in districts outside of Pennsylvania, 1913–1928. Data represent the average amounts per net ton received f. o. b. mines

In a large portion of the area west of the Mississippi the long rail or water-and-rail haul requires a retail price for Pennsylvania anthracite that is practically prohibitive to most householders. It is in this territory that the relatively near-by western hard coals can be sold at retail prices approximating, and even in some cases exceeding,[40] the retail prices obtained for the Pennsylvania product on the Atlantic seaboard. In comparison with the average value of "Virginia anthracite," sold under intensively competitive conditions, the average value of the western hard coal has been the higher during each of the 16 years studied, and the differential has at times exceeded $2 per ton. Also, from 1913 through 1923, the average values for the western region (on all hard coal produced, including steam grades as well as prepared sizes) exceeded those for Pennsylvania anthracite; for the period 1924–1928 the situation was reversed (partly owing to the wage increases in Pennsylvania already referred to), and differentials prevailed in favor of Pennsylvania anthracite. Comparing 1928 with 1913, the relative increase in the average value of western hard coal was 68 per cent as contrasted with an increase of 145 per cent in the average value per net ton of all Pennsylvania anthracite. The comparatively favorable marketing situation of the western hard coal with respect to prices has resulted in average values that at times closely approximate those of Pennsylvania anthracite and exceed those for "Virginia anthracite" by a considerable margin.

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[40] See prices quoted for December, 1927 and 1928, for "Colorado anthracite" in Denver and Salt Lake City; for "New Mexico anthracite" in San Francisco; and for "Arkansas anthracite" in Kansas City, Mo., Dallas, Tex., and Little Rock, Ark. Monthly Labor Review, vol. 28, No. 2, February, 1929, pp. 163–164.

Of the three districts in the western region that in Arkansas has the largest output and probably enjoys the widest market. In some years its production, coming from the coal beds near Spadra and Russellville, has been more than double the combined tonnage of Colorado and New Mexico. The maximum record for "Arkansas anthracite" was reached in 1928, but output for any of the other years since 1923 was not far below the 1928 level.

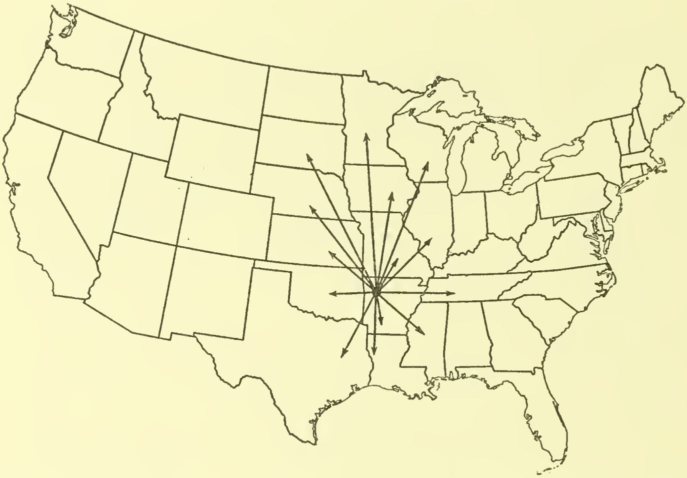

FIGURE 28.—Distribution of "Arkansas anthracite" for the coal year April 1, 1928, to March 31, 1929. The broad market for this coal is indicated by the arrows, which show shipments into 14 States

Distribution of western hard coal.—As shown in Figure 28, the Arkansas operators are prepared to and do serve consumers over an unusually broad area, covering 14 States. The graph depicts distribution figures for the coal year April 1, 1928, to March 31, 1929. Twenty-four per cent of the shipments during this period went to Kansas; Minnesota received 19 per cent, Missouri 14 per cent, Oklahoma 13 per cent, Nebraska 12 per cent, Iowa 6 per cent, and Texas 3 per cent; South Dakota, Illinois, and Louisiana 1 per cent each; and Mississippi, Wisconsin, and Tennessee less than one-tenth of 1 per cent each. The remaining 6 per cent stayed in Arkansas. These data show that a huge area, including the west half of the Mississippi Valley from the Gulf to Canada, constitutes the normal distribution territory for "Arkansas anthracite."

Four main sizes are prepared for shipment in the Arkansas field—grate, egg, No. 4 (closely approximating nut), and slack. Dry screening for sizes is the dominant method of preparation.

A considerable quantity of "Arkansas anthracite" screenings is sold to zinc smelters in the gas fields of Oklahoma and Kansas. In 1928 the amount disposed of in this way constituted 16 per cent of the total shipments. At the smelters the screenings are used in the retorts to reduce the zinc ore and for this purpose constitute an ideal dry, high-carbon, noncoking coal. Some of the slack is also delivered in the Kansas City (Mo.) district as a raw material for briquetting purposes. As in other branches of the coal industry, however, there is frequently a surplus of screenings over and above smelter and other requirements.

"Colorado anthracite," produced in the Crested Butte field of central Colorado, is also distributed widely. According to information available for 1922 Denver consumes more than any other city, while San Francisco is next and Kansas City third. At times shipments have penetrated into Mexico, British Columbia, and even Alaska.[41]

Like the Colorado product, the "New Mexico anthracite" brings premium prices wherever it enters the coal trade. It is produced from a coal seam at Los Cerrillos, near Albuquerque, N. Mex., and it is marketed principally in the Southwestern States and in Mexico. According to the New Mexico State mine inspector's report, the 1927–28 production was sold in California, New Mexico, Texas, Kansas, and Nebraska, and in Old Mexico.[42]

Men employed, time worked, and output per man per day.—Various details of operation in the hard-coal industry outside of Pennsylvania are shown in Table 90. In recent years more than 2,000 men have been employed, and between one-fourth and one-fifth of these were in the eastern region. Although Virginia had a smaller total output and employed fewer men during each of the three years, its average daily production per man was somewhat higher than that of the combined western districts. The specific performance in terms of productivity per man per day in each of the western districts is obscured by the necessity of using an average for the group. In fairness, it should be said that one and often two of these districts exceed the average daily output per man of the eastern region. For both eastern and western regions the average daily output per man was 2.47, 2.41, and 2.26 net tons in 1926, 1927, and 1928, respectively—somewhat above the average daily production of 2.09, 2.15, and 2.17 net tons per man in the Pennsylvania anthracite industry in the same years.

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[41] Schloss, Charles M., Crested Butte Field Produces Four Kinds of Coal from a Territory Five Miles Wide: Coal Age, vol. 22, No. 17, Oct. 26, 1922, p. 667.

[42] State Inspector of Coal Mines, Seventeenth Annual Report to the Governor of New Mexico for the Year Ending Oct. 31, 1928, p. 45.

TABLE 90.—*Production, value, men employed, days worked, and output per man per day at the principal hard-coal mines outside of Pennsylvania in 1926–1928*

State	Net tons				Value		Number of employees					Average number of days worked	Average tons per man per day
							Underground						
	Loaded at mines for shipment	Sold to local trade and used by employees	Used at mines for power and heat	Total quantity	Total	Average per ton	Miners, loaders, and shot firers	Haulage and track	All others	Surface	Total		
1926													
Virginia	244, 507	13, 822	5, 494	263, 823	$1, 072, 556	$4. 07	198	30	55	121	404	256	2. 55
Arkansas, Colorado, and New Mexico	555, 261	10, 954	13, 087	579, 302	2, 778, 892	4. 80	880	96	222	405	1, 603	148	2. 44
	799, 768	24, 776	18, 581	843, 125	3, 851, 448	4. 57	1, 078	126	277	526	2, 007	170	2. 47
1927													
Virginia	145, 474	9, 579	3, 775	158, 828	449, 059	2. 83	246	48	33	100	427	132	2. 82
Arkansas, Colorado, and New Mexico	479, 912	4, 665	8, 464	493, 041	2, 459, 616	4. 99	916	136	275	328	1, 655	129	2. 31
	625, 386	14, 244	12, 239	651, 869	2, 908, 675	4. 46	1, 162	184	308	428	2, 082	130	2. 41
1928													
Virginia	160, 558	7, 724	3, 614	171, 896	477, 187	2. 78	356	49	33	112	550	128	2. 45
Arkansas, Colorado, and New Mexico	522, 490	5, 749	12, 271	540, 510	2, 506, 791	4. 64	1, 175	170	205	353	1, 903	129	2. 20
	683, 048	13, 473	15, 885	712, 406	2, 983, 978	4. 19	1, 531	219	238	465	2, 453	129	2. 26

Stimulated by the relatively strong coal market in 1926, all other hard-coal operations worked an average of 170 days. With the reassertion of depressed conditions in 1927, average working time declined to 130 days. In 1928 it was 129 days, compared with 203 days for the entire bituminous industry and with 217 days for Pennsylvania anthracite. A study of records not available for publication shows that in 1926 the hard-coal districts in two States worked more steadily than the bituminous mines in the same States. In 1928, as in 1927, this was true of only one of the districts.

With an average working time of 129 days, the 1928 output of 712,406 tons represents a daily production of about 5,500 tons. It may therefore be stated that, assuming an average working time of 280 days, these mines have a demonstrated capacity, with existing labor force and working conditions, of at least 1,540,000 tons a year.

Approximately 2 per cent of the total output of all other hard coal is used for fuel at the mines. Another 2 per cent is sold locally, and the remaining 96 per cent is loaded for shipment to market.

DETAILED STATISTICS OF PENNSYLVANIA ANTHRACITE

STATISTICAL SUMMARY

The salient developments in the anthracite industry during the decade following the World War are summarized in Table 1A. The course of the industry is traced through the varying conditions of the past 10 years, including the bituminous coal shortage of 1920, the strike of 1922 (the effects of which were apparent far into 1923), the great strike of 1925–26, and the subsequent readjustments in 1927 and 1928. These changing conditions are reflected in the statistical record of production, consumption, and distribution; of sales realization and sizes shipped; and of men employed, time worked, and time lost through strikes.

TABLE 1A.—*Salient statistics of the Pennsylvania anthracite industry, 1919–1928*

	1919	1920	1921	1922	1923
Production:					
Loaded at mines for shipment—					
Breakers gross tons	64, 631, 703	63, 598, 683	67, 981, 416	37, 906, 503	69, 288, 426
Washeries do	3, 016, 903	4, 615, 514	1, 308, 436	2, 600, 481	3, 754, 287
Dredges do	323, 689	396, 566	264, 711	566, 854	384, 999
Sold to local trade and used by employees gross tons	2, 107, 876	2, 586, 163	2, 511, 206	2, 123, 393	2, 900, 314
Used at mines for power and heat gross tons	8, 573, 580	8, 801, 511	8, 714, 098	5, 626, 896	7, 010, 375
Total do	78, 653, 751	79, 998, 437	80, 779, 867	48, 824, 127	83, 338, 401
Value at breaker, washery, or dredge	$364, 927, 000	$434, 252, 000	$452, 305, 000	$273, 700, 000	$506, 787, 000
Average sales realization per gross ton on breaker shipments:					
Stove	$6. 22	$7. 51	$7. 67	$8. 03	$8. 56
Pea	$4. 81	$5. 70	$5. 74	$5. 92	$6. 18
Total domestic	$6. 01	$7. 23	$7. 39	$7. 77	$8. 23
Buckwheat No. 1	$3. 17	$3. 76	$3. 43	$3. 56	$3. 48
Buckwheat No. 2	$2. 34	$2. 69	$2. 27	$2. 37	$2. 23
Total steam	$2. 63	$3. 22	$2. 75	$2. 77	$2. 64
All sizes	$5. 19	$6. 16	$6. 27	$6. 48	$6. 77
Percentage by sizes in total breaker shipments:					
Broken per cent	4. 5	5. 2	3. 7	4. 3	5. 0
Egg do	14. 9	15. 6	15. 0	14. 5	15. 7
Stove do	20. 5	19. 3	21. 5	21. 5	19. 6
Chestnut do	26. 4	26. 3	27. 2	25. 8	25. 6
Pea do	9. 1	7. 9	8. 4	7. 8	8. 0
Steam sizes do	24. 6	25. 7	24. 2	26. 1	26. 1
Exports gross tons	4, 443, 000	4, 825, 000	4, 176, 000	2, 366, 000	4, 545, 000
Imports do	74, 000	28, 000	8, 000	209, 000	268, 000
Consumption (calculated) do	72, 784, 000	76, 595, 000	73, 170, 000	50, 713, 000	77, 602, 000
Average number of days worked	266	271	271	151	268
Man days lost on account of strikes and lockouts	235, 553	1, 815, 316	823, 279	19, 623, 026	2, 629, 418
Number of men on strike during year	35, 139	96, 840	52, 117	142, 442	135, 585
Average number of men employed	154, 571	145, 074	159, 499	156, 849	157, 743
Output per man per day gross tons	1. 91	2. 04	1. 87	2. 06	1. 97
Output per man per year do	509	552	506	312	529
Quantity cut by machines do	1, 406, 433	837, 565	874, 237	448, 922	1, 079, 055
Quantity produced by stripping do	1, 791, 856	1, 834, 322	1, 810, 527	847, 987	2, 020, 623
Distribution:					
Total receipts in New England[1] net tons	10, 578, 000	11, 255, 000	11, 374, 000	6, 471, 000	12, 185, 000
Exports to Canada do	4, 865, 912	4, 968, 282	4, 519, 216	2, 572, 450	4, 988, 837
Loaded into vessels at Lake Erie[2] net tons	4, 535, 688	4, 032, 989	4, 265, 714	1, 381, 946	3, 512, 079
Receipts at Duluth-Superior[3] net tons	1, 795, 257	1, 637, 477	1, 844, 642	566, 362	1, 419, 984

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[1] From records of the Massachusetts Special Commission on the Necessaries of Life.
[2] From records of the Ore and Coal Exchange.
[3] From records of the United States Engineer Office, Duluth, Minn.

TABLE 1A.—*Salient statistics of the Pennsylvania anthracite industry, 1919–1928*—Continued

	1924	1925	1926		1927	1928
			Old method[4]	New method[4]		
Production:						
Loaded at mines for shipment—						
Breakers gross tons	67, 592, 270	46, 615, 423	65, 826, 189		61, 129, 944	57, 635, 506
Washeries do	1, 060, 354	872, 276	1, 067, 810		1, 317, 623	1, 245, 192
Dredges do	318, 357	519, 776	354, 947		494, 653	483, 231
Sold to local trade and used by employees gross tons	2, 717, 803	2, 575, 515	2, 399, 474		2, 720, 330	2, 843, 594
Used at mines for power and heat gross tons	6, 817, 343	4, 610, 893	5, 742, 162		5, 851, 346	5, 067, 539
Total do	78, 506, 127	55, 193, 883	75, 390, 582		71, 513, 896	67, 275, 062
Value at breaker, washery, or dredge	$477, 231, 000	$327, 665, 000	$474, 164, 000		$420, 942, 000	$393, 638, 000
Average sales realization per gross ton on breaker shipments:						
Stove	$8. 74	$8. 79	$9. 09	$9. 14	$8. 86	$8. 72
Pea	$5. 60	$5. 27	$5. 98	$5. 98	$5. 90	$5. 00
Total domestic	$8. 25	$8. 30	$8. 60	$8. 66	$8. 33	$8. 09
Buckwheat No. 1	$2. 94	$2. 49	$2. 39	$2. 52	[5] $2. 56	[5] $2. 75
Buckwheat No. 2	$1. 93	$1. 84	$1. 78	$1. 78	$1. 78	$1. 85
Total steam	$2. 25	$2. 00	$1. 88	$1. 94	$1. 98	$2. 12
All sizes	$6. 70	$6. 59	$6. 78	$6. 84	$6. 50	$6. 38
Percentage by sizes in total breaker shipments:						
Broken per cent	2. 7	2. 6	1. 6		1. 0	0. 7
Egg do	14. 5	13. 5	13. 5		11. 7	11. 7
Stove do	22. 2	24. 4	25. 1		25. 9	25. 6
Chestnut do	26. 5	26. 8	27. 1		26. 4	25. 4
Pea do	8. 3	5. 6	5. 5		6. 2	7. 8
Steam sizes do	25. 8	27. 1	27. 2		28. 8	28. 8
Exports gross tons	3, 587, 000	2, 838, 000	3, 598, 000		2, 969, 000	2, 979, 000
Imports do	105, 000	342, 000	727, 000		106, 000	343, 000
Consumption (calculated) do	72, 069, 000	57, 197, 000	68, 947, 000		66, 671, 000	65, 759, 000
Average number of days worked	274	182	244		225	217
Man days lost on account of strikes and lockouts	1, 143, 630	15, 269, 506	5, 990, 477		159, 242	400, 682
Number of men on strike during year	71, 273	147, 928	145, 376		20, 478	36, 128
Average number of men employed	160, 009	160, 312	165, 386		165, 259	160, 681
Output per man per day gross tons	1. 79	1. 89	1. 87		1. 92	1. 93
Output per man per year do	491	345	456		433	419
Quantity cut by machines do	1, 271, 325	840, 347	831, 183		1, 046, 329	1, 151, 615
Quantity produced by stripping do	1, 665, 783	1, 409, 355	2, 144, 068		1, 922, 461	2, 163, 325
Distribution:						
Total receipts in New England[1] net tons	10, 611, 000	8, 280, 000	10, 608, 000		9, 145, 000	9, 376, 000
Exports to Canada do	3, 927, 999	3, 096, 815	3, 941, 718		3, 238, 564	3, 296, 487
Loaded into vessels at Lake Erie[2] net tons	3, 094, 088	1, 793, 516	2, 857, 917		1, 918, 389	1, 420, 882
Receipts at Duluth-Superior[3] net tons	1, 289, 994	790, 132	1, 272, 973		981, 194	652, 095

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[1] From records of the Massachusetts Special Commission on the Necessaries of Life.

[2] From records of the Ore and Coal Exchange.

[3] From records of the United States Engineer Office, Duluth, Minn.

[4] The figures under the heading "Old method" are computed so as to be exactly comparable with the earlier years. Those under the heading "New method" are based on a more accurate system of estimating the values of one company which reported quantities but not values and (except for buckwheat No. 1) are strictly comparable with the figures for 1927 and 1928. (See Coal in 1926, p. 576, and Coal in 1927, pp. 502–503.)

[5] The averages for buckwheat No. 1 in 1927 and 1928 were computed according to the "Old method" and are comparable with the figure of $2.39 in 1926 and with those given for 1918 to 1925. (See Coal in 1927, pp. 502–503.)

THE ANTHRACITE SITUATION

Since the 1925–26 strike both the production and the consumption of Pennsylvania anthracite have declined. An important factor in bringing about this condition has been the increased use of other fuels for anthracite, 70 per cent of which is used in the heating of homes.

From 1913 through 1926 there was practically no increase in the production of anthracite. In normal years output remained almost stationary, although in the meantime the population of the territory served by the anthracite region steadily increased. Although no disturbance affected mining during 1927 and 1928, production failed to equal the average of other recent years. The total for 1928, 67,275,062 gross tons, is the smallest on record for any year free from labor difficulties over a long period.

Losses in shipments and increased use of fuels in place of anthracite.—The decline in anthracite shipments during 1927–28 has led to many inquiries as to where the losses occurred, to what extent they were affected by unusual conditions, and to what extent they were due to competitive fuels. A complete answer to these questions would require a long-time record of detailed comparative figures for small areas on all fuels used for domestic purposes. No such figures are available. A partial answer is given, however, by assembling such data as are accessible on the quantity of anthracite shipped to certain of the larger markets and on the trend of consumption of other house fuels. (Tables 1A and 2A.) It will be seen from these data that while the anthracite industry regained the vast majority of its former customers after the strike of 1925–26 the decline in hard-coal shipments and the figures on sales of competitive fuels indicate some losses of trade that have not yet been recovered. (For a more complete analysis see pp. 477–481, Coal in 1927.)

TABLE 2A.—*Commercial production of Pennsylvania anthracite and total supplies of other fuels used for domestic purposes in the United States, 1925–1928*

[The figures for 1925 and 1926 were affected by the great strike of the anthracite miners which lasted from Sept. 1, 1925, to Feb. 18, 1926]

	1925	1926	1927	1928
Solid fuels (net tons)				
Pennsylvania anthracite production:				
Shipments of domestic sizes	38,305,222	54,096,437	48,999,058	46,218,403
Shipments of buckwheat No. 1[1]	6,631,604	8,581,966	9,062,977	8,769,923
Shipments of smaller steam sizes	8,831,546	12,640,417	12,433,251	11,499,274
Local sales	2,884,577	2,687,411	3,046,770	3,184,825
Total commercial production	56,652,949	78,006,231	73,542,056	69,672,425
Anthracite exported	3,179,006	4,029,683	3,325,507	3,336,272
Anthracite imported, chiefly from United Kingdom	382,894	813,956	119,030	384,707
Fuel briquets produced	839,370	995,332	970,468	947,423
Fuel briquets imported	6,758	123,593	60,601	71,485
By-product coke sold for domestic use	4,085,068	5,056,568	4,702,529	6,254,382
Beehive coke sold for domestic use	392,698	386,045	111,103	78,338
Coke imported	201,579	284,548	168,859	147,701
Gas-house coke sold	(2)	(2)	(2)	(2)
Petroleum coke produced[3]	991,000	995,300	1,145,200	1,426,600
Anthracite and semianthracite produced outside of Pennsylvania	786,594	843,125	651,869	712,406
Bituminous coal for domestic use[4]	(5)	(5)	(5)	(5)
Oil (barrels)				
Oil used for heating houses[6]	5,000,000	9,080,000	[7] 11,709,000	13,967,000
Oil used for heating offices, hotels, apartments, schools, hospitals, and buildings other than houses	[8] 12,100,000	[7] 13,874,000	[7] 15,751,000	16,704,000
Gas (million cubic feet)				
Natural gas consumed for domestic use	272,146	289,175	296,036	320,877

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[1] A considerable part of the buckwheat No. 1 is used for domestic purposes.

[2] From 1,300,000 to 1,500,000 tons a year.

[3] How much petroleum coke was used for house fuel prior to 1928 is not known. For that year 235,000 tons was reported to have been consumed in domestic heating, according to a study made by E. B. Swanson, U. S. Bureau of Mines.

[4] During the anthracite strike about 17,000,000 tons of bituminous coal, in addition to the normal consumption, was used to replace anthracite.

[5] From 56,000,000 to 77,000,000 tons a year.

[6] Figures for 1925 relate to the heating season of 1924–25. Figures for 1926, 1927, and 1928 represent the calendar year.

[7] Revised according to surveys made by E. B. Swanson, U. S. Bureau of Mines.

[8] Partly estimated.

Decline in prices of domestic coal.—The course of anthracite prices during the last two years has afforded a striking contrast with the steady increase that characterized the period from 1913 through 1926. Average values of the domestic sizes reached high levels in the period from 1924 to 1926 and have since slowly but steadily declined. A comparison of value figures for the peak year of 1926 with those for 1928, however, might be misleading, as the after-effects of the 1925–26 suspension were felt throughout 1926 when no summer discounts were offered because of the brisk demand. Consequently, for conservatively measuring the trend of prices under more stable conditions than those that prevailed during and after the last strike, 1924 rather than 1926 is considered the best year to compare with 1928. Market conditions in both 1924 and 1928 were comparatively tranquil, wage rates were the same, and approximately the same summer discounts were offered.

In comparison with 1924, the 1928 average sales realizations on breaker shipments show declines for all sizes in the domestic group with one unimportant exception.[43] The decrease from 1924 to 1928 in the average of all sizes of domestic coal was 16 cents per ton, or 2 per cent. (Table 20A.) On specific grades the decreases ranged from 2 cents a ton for stove to 60 cents a ton on pea, with a single exception as previously noted.

Over the same period the average value of all steam sizes shipped from breakers declined from $2.25 to $2.12. The grand average for all sizes, including steam and domestic coal, was 32 cents less per ton in 1928 than in 1924.

During the past two years independent prices of domestic sizes have been generally lower than company prices, a result of relatively weak demand accompanied by an abundant supply of anthracite. For the first time in 10 years independent stove coal, as quoted in the New York market, remained below the circular price throughout 1927 and for most of 1928. (Coal Age, vol. 34, No. 1, January, 1929, p. 58.) At no time since the war has this quotation on independent stove been so far below the company price as in 1927 and 1928. Throughout 1924 premiums were paid for independent stove and also for most of the larger domestic sizes of independent coal during all or a greater part of the year, in contrast to an almost complete absence of such premiums in 1928. (Saward's Annual: 1925, pp. 20–21; 1929, pp. 20–21.)

Prices of coal to consumers include freight charges to points of consumption plus wholesalers' and retailers' margins, amounting in all to almost as much as the price of the coal at the mouth of the mine. Hence, a cut in the mine price is ordinarily reflected by a much smaller relative reduction in the retail price. Since 1924, however, retail prices of anthracite have shown noticeable decreases. According to tabulations of coal prices, made by the Bureau of Labor Statistics, the average retail price of anthracite stove for the United States declined from $15.24 in July, 1924, to $14.91 in July, 1928. (Monthly Labor Review, vol. 29, No. 2, August, 1929, p. 210.) Over the same period the average retail price of chestnut dropped from $15.10 to $14.63. Declines of 33 and 68 cents per ton for stove and chestnut, respectively, are noted when the average retail prices of the two sizes in January, 1928, are compared with those for the same month of 1924.

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[43] The average value of broken in 1928 was $8.10, as against $7.93 in 1924. It should be noted that this size comprised less than 1 per cent of the total shipments in 1928. (Table 16A.)

The available barometers of prices—such as average realizations at the mines, company prices, independent quotations in the New York market, and average retail prices paid by consumers—all indicate that there has been a considerable adjustment in the price structure of anthracite with the changing needs of the market.

THE MOVEMENT TOWARD MECHANIZED HEATING

One close observer of the domestic fuel market in New England has noted that:

> The domestic fuel problem * * * is somewhat different from 10 years ago; revolutionary changes have occurred in the kinds of fuels used and their combustion. Instead of buying so much fuel, the consumers now give primary attention to the actual cost of heating their homes, including the amount of labor required.[44]

In this connection the use in homes of the gas furnace and the oil burner is an example of the tendency toward automatic heating, which is perhaps the most interesting development in the field of household fuel. These devices have taught the householder the luxury of automatic heat, and this luxury is increasing in favor with the public.

Oil as a domestic fuel.—Househeating with oil has been given great impetus through organized effort and advertising, in which publicity programs, instituted by the American Oil Burner Association and its affiliated Oil Heating Institute and carried on with encouragement from the American Petroleum Institute, have been important factors.

According to a study made by E. B. Swanson, of the Bureau of Mines, the consumption of oil by householders in 1928 was 13,967,000 barrels, an increase of 19 per cent over 1927 and a gain of 54 per cent in the two years since 1926. As much of the oil is used in areas where bituminous coal is the chief fuel, it is clear that the anthracite market is affected by only a part of the oil consumed for househeating.

In addition to the increased use of oil for heating homes, the quantity consumed for heating other buildings has shown a steady but slower growth. In 1928, 16,704,000 barrels were used for this purpose, an increase of 6 per cent over 1927 and of 20 per cent over 1926. (Table 2A.)

Househeating with manufactured gas.—Although the number of houses heated with manufactured gas is still small, the movement is increasing at a rapid rate. In five New England States (excluding Connecticut) 3,366 homes were reported as using gas for central househeating on October 1, 1928, an increase of 866 and 2,066 over 1927 and 1926, respectively.[45] In Massachusetts alone 2,925 homes were heated with gas during the coal year 1928–29, an increase of 1,185 over the preceding coal year.[46] In Maryland, where practically all the installations are in Baltimore, 1,816 homes were heated with gas in 1928, in comparison with 19 installations in 1916. Most of the increase has come during the past three years. According to a survey conducted by the Househeating Committee of the American Gas Association, in 1928 there were at least 43 central househeating installations in Delaware, 903 in New Jersey, 307 in the District of Columbia, 278 in Minnesota, and 600 in Wisconsin.[47]

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[44] Massachusetts Special Commission on the Necessaries of Life, Summary of Fuels Used for Heating Homes in Massachusetts, May 16, 1929.

[45] Data are based on a survey made by the New England Bureau of Public Service Information. The total number of installations for the six New England States in 1928 was 3,960. Figures for Connecticut are not available for years prior to 1928.

[46] Massachusetts Special Commission on the Necessaries of Life, Summary of Fuels Used for Heating Homes in Massachusetts, May 16, 1929.

The consumer desiring to heat with gas entails the expense of installing either a special furnace or a conversion of his existing equipment and pays a higher fuel bill than when he burns coal. For example, in Baltimore where gas is sold for househeating at approximately 65 cents per M cubic feet, the price of the gas according to the company is equivalent to anthracite at $22 a ton. According to another company, the cost of heating with manufactured gas in Malden, Mass., ranges from 50 to 100 per cent more than the cost of heating with coal. The extra investment in the furnace and the high cost of the fuel indicate that gas heating is a luxury, but it is evidently a luxury for which many families will gladly pay in order to be rid of the labor of stoking the fire and handling ashes.

Automatic heat and anthracite.—Regarding automatic heat, the anthracite industry is assisting the development of equipment for burning the fine sizes of coal automatically so as to give the same service as oil and gas.

While there has been remarkable progress of late years in the utilization of coal for industrial purposes, so that coal will give practically all the advantages of oil as a boiler fuel and in most locations at lower cost, there have been until lately very few changes in the design of domestic coal furnaces. Recent advances have been made, however, in heating homes automatically with anthracite, as indicated by the number of small automatic stokers now on the market. These can burn the cheaper fine sizes of anthracite a pinch at a time with automatic feed, automatic control of draft and feed by thermostat, and sometimes automatic removal of ash into a container. Generally, the grate is fed from a large hopper which seldom has to be filled with fresh coal more than once a day. This can be done by the man of the house at any time he happens to be home, thus eliminating all trips to the furnace by the housewife. Or one service man could attend to a large number of these machines. Data on the total number of automatic stokers burning anthracite used in heating homes throughout the United States are not available, but at the end of 1928 considerable progress in their introduction was reported in the cities of Baltimore, New York, Chicago, and Washington.

In addition to automatic stokers, much interest is attached to the increased use of improved types of magazine heaters for central househeating. These heaters are admirably suited for burning the finer sizes of anthracite and seldom require firing more than once a day. The general characteristic of the magazine heater is a large hopper on the inside of the furnace which feeds the fine coal onto the fire bed as rapidly as necessary. The sales of one manufacturer of this type of boiler increased 100 per cent in 1928, as compared with the preceding year, and 95 per cent of the installations were made in what is regularly recognized as the anthracite-consuming territory. Another manufacturer reported a steady growth in sales from 1926 to 1928, and the increases during 1928 were most pronounced in the Metropolitan district of New York, the Philadelphia district, the northeastern section of Pennsylvania, and in the northern half of New York State.

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[47] The figures are probably below the real totals, as some companies did not report the number of central heating installations.

Following the trend of change in the central househeating equipment field, there has also been a large improvement in the design, efficiency, and appearance of "magazine-fed circulating stoves." Stoves are still a factor of no small importance in domestic heating, and such scattered records of sales as are available indicate that progress is being made in the introduction of the new equipment among a limited class of consumers.

ANTHRACITE'S EFFORT TO MEET COMPETITION

The statistical data available on the inroads of competitive fuels and the losses in various markets are not sufficiently complete to permit a forecast, for they cover only a few of the many factors in the economic environment of the anthracite industry. Not the least significant factor is the determined and organized effort of the producers to recover and expand their markets. The Anthracite Operators' Conference, representing both company and independent operators, is leading the attack upon the industry's merchandising problems. One of the efforts of the conference has been to establish better relations between the producer and the retailer. By making a real effort to understand the retailer's problems, by training his salesmen in the fundamentals of combustion engineering, and by greater participation of anthracite executives in meetings of retail dealers much is said to have been done to improve the coal merchant's attitude toward anthracite.

Another effort of the Anthracite Operators' Conference has been to bring about certain mechanical improvements in the anthracite breakers in order that the consumer's favor may be held with carefully cleaned and properly sized coal. In 1928 the merchandising committee of the conference recommended new sizing standards to replace those adopted in 1925. (Coal Age, vol. 33, No. 8, August, p. 468.) In comparison with the 1925 specifications, the latest standards, summarized in the following table, make a 1 per cent reduction in the permissible slate in egg, stove, and nut, reduce the maximum undersize in nut and pea, and also establish screen standards for the steam sizes.

Anthracite preparation standards

[Round-mesh screens]

Size	Testing screen mesh		Maximum permissible					
			1925 standards			1928 standards		
	Through—	Over—	Undersize	Slate	Bone	Undersize[1]	Slate	Bone
	Inches	*Inches*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
Broken	4 7/16	3 7/16	15	2	2	15	2	2
Egg	3 7/16	2½	15	3	3	15	2	3
Stove	2½	1 9/16	15	4	4	15	3	4
Nut	1 9/16	11/16	[2] 15	5	5	10	4	5
Pea	11/16	½	15	7½	7½	10	7½	7½
Buckwheat[3]	9/16	5/16						
Rice[3]	5/16	3/16						
Barley[3]	3/16	3/32						
Boiler	5/16	3/32						

[1] Permissible oversize, broken or buckwheat, inclusive, a maximum of 5 per cent.
[2] Plus not more than 5 per cent unavoidable breakage.
[3] Not covered in 1925 standards.

Cooperation with dealers in sales effort.—The most active agency of the operators in the direct promotion of anthracite sales is the Anthracite Coal Service. This organization, which had but one employee at the beginning, now maintains a force of about 75 men. It originally devoted most of its energies holding business for the steam sizes of anthracite, but demand has forced it to give more and more attention to retail distribution problems. Headquarters for the service are maintained in Philadelphia and branch offices in Washington, Baltimore, Albany, New York City, Boston, Syracuse, Detroit, Chicago, Milwaukee, Minneapolis, St. Paul, and Toronto (Canada). In addition, subbranch offices of the Anthracite Service, which are administered through the branches, are located in a number of the other more important cities. Finally, the engineering corps of the service is at the call of retail distributors in other than branch and subbranch office cities.

The Anthracite Coal Service sponsors, among other things, combustion schools for retailers. These schools train the employees of the retail coal merchants in the fundamentals of combustion, plant inspection, and servicing the consumer. Since starting at Trenton, in the early part of 1927, the Anthracite Coal Service has trained 2,007 representatives of 1,263 retail companies in 81 communities. During the month of December, 1928, it conducted classes in 23 cities with 546 employees of over 337 dealers enrolled. In cities where the training course has been completed or is well advanced cooperative newspaper advertising, paid for jointly by the anthracite producers and by the local dealers, is available to retailers.

Besides serving the consumer directly upon application and in addition to the task of training dealers or their employees, the service engineers are available for consultation with reference to problems in commercial heating and in the use of fuel for industrial purposes. (See Anthracite Coal Service, vol. 1, No. 8.)

The Anthracite Coal Service also publishes a monthly pamphlet, The Anthracite Salesman, of which over 12,000 copies are distributed, principally to retailers. This pamphlet features methods employed by retailers in merchandising anthracite and contains suggestions for increasing and improving business. Another publication, The Anthracite Coal Service Magazine, was sent to about 10,000 engineers, architects, and building owners in an effort to impress upon them the advantages of hard coal. The Anthracite Bureau of Information, another agency of the Operators' Conference, has assisted the Anthracite Coal Service in most of its work.

Early in 1928 a group of companies, including a number of independent producers and all but two of the large companies, launched a cooperative newspaper advertising campaign in the anthracite-consuming territory. This was followed by a 24-sheet poster billboard campaign, started in June. The group in this venture advertised their product as "Cert-i-fied anthracite." Retail distributors were furnished with metal signs featuring this name and with stickers to place on delivery tickets. Approximately $600,000 was appropriated for this cooperative advertising campaign.

TABLE 3A.—*Average retail prices of stove anthracite and of bituminous coal in representative cities, by months, 1924–1928, as reported by the Bureau of Labor Statistics*

[From Monthly Labor Review. All figures in net tons of 2,000 pounds except as noted. Prices represent sidewalk delivery. Grades of bituminous coal were not specified]

Month	Anthracite, white-ash stove				Bituminous coal		
	Baltimore [1]	Boston	New York	Chicago	Chicago	Detroit	Norfolk
1924							
January	$16.75	$16.00	$14.42	$17.00	$8.69	$9.48	$8.83
February	16.75	15.30	14.38	17.00	8.73	9.63	8.97
March	16.75	15.50	14.33	16.75	8.56	9.52	9.00
April	15.50	15.50	13.50	16.08	8.06	9.45	8.97
May	15.50	15.50	13.57	16.08	7.85	9.32	8.22
June	15.50	15.50	13.63	16.25	7.85	9.14	8.22
July	15.79	15.70	13.70	16.25	7.85	9.18	8.25
August	15.75	15.75	13.78	16.50	7.85	9.07	8.28
September	16.29	16.00	14.13	16.50	7.83	9.07	9.00
October	16.29	16.00	14.13	16.75	8.21	9.21	9.00
November	16.25	16.00	14.13	16.75	8.13	9.25	9.00
December	16.25	16.00	14.33	16.75	8.14	9.07	9.25
1925							
January	16.25	16.00	14.33	16.74	8.51	8.93	9.27
February	16.25	16.00	14.42	16.74	8.50	8.96	9.27
March	16.25	16.00	14.42	16.70	8.48	8.83	9.27
April	15.50	15.75	14.00	16.70	8.41	8.77	9.27
May	15.50	15.75	14.02	16.10	8.06	8.70	8.57
June	15.75	15.75	14.12	16.30	8.23	8.70	8.52
July	15.75	16.00	14.22	16.30	8.21	8.79	8.48
August	16.00	16.00	14.37	16.36	8.32	8.89	8.52
September	16.00	16.25	15.13	16.77	8.89	9.73	9.05
October	16.21	16.25	17.04	17.19	8.99	9.86	9.05
November	(2)	17.00	20.50	18.13	9.65	10.59	10.43
December	(2)	17.80	(2)	18.13	9.49	10.70	10.52
1926							
January	(2)	(2)	(2)	(2)	9.48	10.59	10.52
February	(2)	(2)	(2)	(2)	9.34	10.53	10.52
March	16.75	18.00	15.71	16.89	8.99	10.69	10.16
April	16.00	16.00	14.75	16.86	8.39	10.45	9.34
May	16.00	16.00	14.75	16.84	8.12	9.33	8.46
June	16.00	16.00	14.75	16.84	8.13	9.24	8.41
July	16.00	16.25	14.75	16.88	8.27	9.30	8.52
August	16.00	16.25	14.75	16.88	8.32	9.25	8.52
September	16.00	16.25	14.75	16.90	8.91	9.90	9.09
October	16.08	16.40	14.75	16.91	9.06	10.39	9.66
November	16.00	16.50	14.75	17.00	10.15	11.61	10.39
December	16.00	16.50	14.75	17.00	10.34	11.05	10.25
1927							
January	16.00	16.50	14.75	17.00	9.85	10.34	9.68
February	16.00	16.50	14.75	17.00	9.64	10.22	9.73
March	16.00	16.50	14.54	17.00	9.31	9.78	9.71
April	15.25	15.75	13.75	16.25	8.89	9.57	8.27
May	15.25	15.75	13.83	16.25	8.98	9.41	8.27
June	15.50	15.75	14.08	16.50	9.12	9.28	8.57
July	15.75	16.00	14.08	16.70	9.09	9.18	8.55
August	15.75	16.00	14.08	16.70	9.16	9.21	8.55
September	16.00	16.00	14.38	16.95	9.32	9.38	8.80
October	16.00	16.25	14.38	16.94	9.30	9.38	9.07
November	16.00	16.25	14.75	16.95	9.29	9.35	9.07
December	16.00	16.25	14.75	16.95	9.17	9.31	9.07
1928							
January	16.00	16.25	14.75	16.95	9.21	9.31	9.05
February	16.00	16.25	14.75	16.95	9.21	9.31	9.09
March	16.00	16.25	14.75	16.95	9.21	9.33	9.05
April	15.17	15.50	14.25	16.95	9.20	9.23	9.05
May	15.00	15.50	14.25	16.00	8.18	9.15	8.55
June	15.25	15.50	14.46	16.25	8.30	8.99	8.55
July	15.25	15.50	14.50	16.25	8.35	9.13	8.55
August	15.25	15.75	14.50	16.25	8.58	9.13	8.55
September	15.75	15.75	14.71	16.50	8.72	8.98	8.50
October	16.00	16.00	14.75	16.75	9.15	9.05	8.55
November	16.00	16.25	14.75	16.90	9.15	9.19	9.07
December	16.00	16.25	14.79	16.90	9.10	9.31	9.07

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[1] Per gross ton.

[2] Insufficient data.

PRODUCTION, BY WEEKS AND MONTHS

The following tables summarize the statistics of the weekly and monthly production of anthracite that are first published in the Bureau of Mines weekly coal reports. Statistics of weekly output of anthracite are estimated from the records of cars of anthracite loaded by the nine railroads that serve the region. The weekly figures, expressed in net tons to facilitate comparisons, have been adjusted to the annual total ascertained by direct canvass of the operators themselves.

The working year in the anthracite region is somewhat less than the average for the bituminous coal industry. The region is completely unionized, and the union holidays are therefore observed by practically all mines. In addition to Eight Hour Day (April 1) and Labor Day, the anthracite miners celebrate Mitchell Day (October 29) in memory of the ending of the famous strike of 1902. Other holidays not observed in the nonunion bituminous fields, such as Memorial Day, Thanksgiving, and Armistice Day, are now generally celebrated in the anthracite region. Beginning with 1927 Washington's Birthday is counted as a half holiday. (See footnote to Table 5A.) In consequence, the theoretical working year for the anthracite mines is 303.5 days, a figure that makes no allowance for church holy days, many of which are so generally observed as to decrease production seriously.

TABLE 4A.—*Estimated weekly production of anthracite in 1928*

Week ended—	Production (net tons)	Number of working days	Average production per working day (net tons)	Week ended—	Production (net tons)	Number of working days	Average production per working day (net tons)
January 7	1,263,000	5	253,000	July 21	1,173,000	6	196,000
January 14	1,562,000	6	260,000	July 28	1,047,000	6	175,000
January 21	1,083,000	6	181,000	August 4	1,143,000	6	191,000
January 28	1,214,000	6	202,000	August 11	1,364,000	6	227,000
February 4	1,550,000	6	258,000	August 18	1,390,000	6	232,000
February 11	1,440,000	6	240,000	August 25	1,700,000	6	283,000
February 18	1,007,000	6	168,000	September 1	1,697,000	6	283,000
February 25	1,231,000	5.5	224,000	September 8	1,096,000	5	219,000
March 3	1,271,000	6	212,000	September 15	1,388,000	6	231,000
March 10	1,459,000	6	243,000	September 22	1,470,000	6	245,000
March 17	1,027,000	6	171,000	September 29	1,819,000	6	303,000
March 24	1,075,000	6	179,000	October 6	1,880,000	6	313,000
March 31	1,284,000	6	214,000	October 13	1,967,000	6	328,000
April 7	1,476,000	5	295,000	October 20	1,958,000	6	326,000
April 14	1,567,000	6	261,000	October 27	1,924,000	6	321,000
April 21	1,576,000	6	263,000	November 3	1,352,000	5	270,000
April 28	1,855,000	6	309,000	November 10	1,753,000	6	292,000
May 5	1,793,000	6	299,000	November 17	1,692,000	5	338,000
May 12	1,856,000	6	309,000	November 24	1,885,000	6	314,000
May 19	1,664,000	6	277,000	December 1	1,599,000	5	320,000
May 26	1,990,000	6	332,000	December 8	1,571,000	6	262,000
June 2	1,464,000	5	293,000	December 15	1,678,000	6	280,000
June 9	1,361,000	6	227,000	December 22	1,466,000	6	244,000
June 16	1,196,000	6	199,000	December 29	890,000	5	178,000
June 23	1,063,000	6	177,000	January 5, 1929	[1] 221,000	[1] 1	[2] 234,000
June 30	1,105,000	6	184,000				
July 7	701,000	5	140,000		75,348,000	303.5	248,000
July 14	1,092,000	6	182,000				

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[1] Figures represent the output and the number of working days in that part of the week included in the calendar year 1928. Figures of total production for the week of Jan. 5, 1929, are 1,169,000 tons.

[2] Average daily production for the entire week and not for the working days that fell in the calendar year 1928.

TABLE 5A.—*Estimated monthly production of anthracite and average production per working day,[1] 1923–1928, in thousands of net tons*

Month	1923		1924		1925		1926		1927		1928	
	Total	Daily average	Total	Daily average	Total	Daily average	Total	Daily average	Total	Daily average	Total	Daily average
January	8,521	328	7,724	297	7,234	278	172	7	6,516	261	5,587	223
February	7,602	317	7,428	297	7,003	292	2,069	86	5,812	247	5,481	224
March	9,175	340	7,908	304	6,886	265	8,732	323	6,056	224	5,398	200
April	7,885	329	6,639	265	7,292	292	8,163	327	7,078	283	6,784	283
May	8,384	322	7,549	290	7,938	318	8,001	320	7,947	318	7,977	307
June	8,474	326	7,509	300	7,616	293	8,878	341	7,207	277	5,205	200
July	8,136	325	7,584	292	8,334	321	8,371	322	4,993	200	4,394	176
August	8,672	321	6,906	266	9,014	347	8,171	314	7,694	285	6,759	250
September	2,853	119	7,408	296	52	2	8,388	336	6,596	264	5,927	247
October	8,532	328	7,479	288	69	3	8,617	345	7,353	294	8,400	323
November	7,575	316	6,604	287	153	7	7,397	308	6,854	286	7,322	305
December	7,530	301	7,189	277	226	9	7,478	288	5,990	230	6,114	245
	93,339	307	87,927	288	61,817	203	84,437	278	80,096	264	75,348	248

[1] Production for 1923 was estimated from monthly shipments as reported by the Anthracite Bureau of Information, for later years from weekly car loadings as reported by the American Railway Association, and includes mine fuel, coal sold locally, dredge coal, and the output of the Bernice Basin in Sullivan County. In computing the average rates per working day New Year's, Eight-Hour Day (Apr. 1), Memorial Day, Independence Day, Labor Day, Mitchell Day (Oct. 29), Thanksgiving Day, Christmas Day, and, since the war, Armistice Day, have been counted as holidays. Beginning with 1927, Washington's Birthday is counted as a half holiday. No allowance, however, has been made for church holy days, which are observed by many of the miners. Monthly statistics from 1905 to 1922 will be found in Coal in 1925, pp. 427–428.

PRODUCTION IN THE LEHIGH, SCHUYLKILL, AND WYOMING REGIONS

The total production of Pennsylvania anthracite in 1928, including colliery fuel and local sales and dredge and washery coal, was 67,275,062 gross tons, and the total value at the mines was $393,637,690. Comparison of the production in 1928 and 1927 shows a decline of 5.9 per cent in quantity and 6.5 per cent in value.

As shown in the analysis of production by regions (Table 6A), 138,221 tons were produced in the Bernice Basin, Sullivan County, a detached outlier of the coal-bearing series to the north and west of the Wyoming area. The Lehigh region produced 8,911,942 tons, the Schuylkill region 21,126,013, and the Wyoming region 37,098,886. Compared with 1927, the Lehigh output declined 9.7 per cent, Schuylkill 4.9 per cent, and Wyoming 5.6 per cent.

Of the total production 59,363,929 tons, or 88.2 per cent, consisted of shipments and 2,843,594 tons of local sales made within the anthracite region or in the vicinity of the river dredges and the mines of Sullivan County. The sum of the two items—62,207,523 gross tons—constituted the "commercial production," and in 1928 it was valued at $385,099,872, or $6.19 per ton as compared with $6.32 in 1927. In addition to shipments and local sales, 5,067,539 tons were used as colliery fuel in 1928. Its value for cost-keeping purposes is placed at $8,537,818.

At this point it should be noted that the figures on value for the period 1926 to 1928 are strictly comparable with each other but not with those for earlier years. In 1926 a change was made in estimating the value of the production of one large company in the Wyoming region, which has reported its tonnage but not its value. The new method, fully explained in Coal in 1926 (pp. 555, 576–580), yields more accurate results than that formerly employed. The change, though slight, should be kept in mind when tables relating to values are considered.

TABLE 6A.—*Anthracite produced, by regions, 1927 and 1928*

Region	Shipments		Local sales		Colliery fuel		Total	
	Gross tons	Value[1]	Gross tons	Value	Gross tons	Value	Gross tons	Value[1]
1927								
Lehigh:								
Breaker product	8,702,751	$52,962,480	408,160	$1,834,358	684,148	$1,641,118	9,795,059	$56,437,956
Dredge product	76,051	89,592					76,051	89,592
	8,778,802	53,052,072	408,160	1,834,358	684,148	1,641,118	9,871,110	56,527,548
Schuylkill:								
Breaker product	17,549,496	106,293,616	615,832	3,715,533	2,305,978	957,400	20,471,306	110,966,549
Washery product	898,680	2,205,031	(2)	(2)	[2]50,076	[2]20,294	948,756	2,225,325
Dredge product	418,602	336,645	368,461	364,091	4,580	4,479	791,643	705,215
	18,866,778	108,835,292	[2]984,293	[2]4,079,624	[2]2,360,634	[2]982,173	22,211,705	113,897,089
Wyoming:								
Breaker product	34,759,359	237,473,149	1,321,338	7,559,452	2,641,810	3,432,708	38,722,507	248,465,309
Washery product	418,943	1,233,874	(2)	(2)	[2]138,134	[2]179,787	557,077	1,413,661
	35,178,302	238,707,023	[2]1,321,338	[2]7,559,452	[2]2,779,944	[2]3,612,495	39,279,584	249,878,970
Sullivan County: Breaker product	118,338	552,239	6,539	45,950	26,620	39,930	151,497	638,119
Total breaker product	61,129,944	397,281,484	2,351,869	13,155,293	5,658,556	6,071,156	[2]69,140,369	416,507,933
Total washery product	1,317,623	3,438,905	(2)	(2)	[2]188,210	[2]200,081	1,505,833	3,638,986
Total dredge product	494,653	426,237	368,461	364,091	4,580	4,479	867,694	794,807
Grand total	62,942,220	401,146,626	[2]2,720,330	[2]13,519,384	[2]5,851,346	[2]6,275,716	71,513,896	420,941,726

1928								
Lehigh:								
Breaker product	7, 865, 312	47, 922, 067	355, 276	1, 716, 465	611, 618	1, 449, 729	8, 832, 206	51, 088, 261
Dredge product	79, 736	103, 445					79, 736	103, 445
	7, 945, 048	48, 025, 512	355, 276	1, 716, 465	611, 618	1, 449, 729	8, 911, 942	51, 191, 706
Schuylkill:								
Breaker product	16, 853, 067	99, 891, 082	617, 380	3, 535, 658	2, 026, 536	3, 567, 125	19, 496, 983	106, 993, 865
Washery product	828, 816	1, 861, 236			37, 628	68, 513	866, 444	1, 929, 749
Dredge product	403, 495	322, 036	345, 885	383, 585	13, 206	12, 464	762, 586	718, 085
	18, 085, 378	102, 074, 354	963, 265	3, 919, 243	2, 077, 370	3, 648, 102	21, 126, 013	109, 641, 699
Wyoming:								
Breaker product	32, 809, 943	219, 151, 694	1, 496, 823	8, 351, 358	2, 327, 490	3, 351, 447	36, 634, 256	230, 854, 499
Washery product	416, 376	1, 136, 352	21, 343	132, 766	26, 911	46, 277	464, 630	1, 315, 395
	33, 226, 319	220, 288, 046	1, 518, 166	8, 484, 124	2, 354, 401	3, 397, 724	37, 098, 886	232, 169, 894
Sullivan County: Breaker product	107, 184	544, 883	6, 887	47, 245	24, 150	42, 263	138, 221	634, 391
Total breaker product	57, 635, 506	367, 509, 726	2, 476, 366	13, 650, 726	4, 989, 794	8, 410, 564	[3]65, 101, 666	389, 571, 016
Total washery product	1, 245, 192	2, 997, 588	21, 343	132, 766	64, 539	114, 790	1, 331, 074	3, 245, 144
Total dredge product	483, 231	425, 481	345, 885	383, 585	13, 206	12, 464	842, 322	821, 530
Grand total	59, 363, 929	370, 932, 795	2, 843, 594	14, 167, 077	5, 067, 539	8, 537, 818	67, 275, 062	393, 637, 690

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[1] Value given for shipments is value at which coal left possession of producing company f. o. b. mines and does not include margins of separately incorporated selling companies.
[2] An insignificant quantity reported as local sales is included under the colliery fuel.
[3] Includes about 1,452,000 tons of culm-bank coal put through the breakers in 1927 and 684,000 tons in 1928.

In Table 7A a comparison made on the basis of shipments shows the relative importance of the three principal producing regions (excluding Sullivan County) over a period extending back to the early days of the industry. Mining began in the Wyoming and then in the Lehigh region, but for the 30 years after 1830 the Schuylkill region was the largest producer. (Coal in 1923, p. 705, fig. 53.) After the Civil War the Wyoming region gained rapidly and since 1885 has supplied 50 per cent or more of the shipments. In the last 20 years there have been only slight temporary changes in the relative percentages, and in 1928 the Wyoming region contributed 56.1 per cent of the shipments, against 13.4 per cent for Lehigh and 30.5 per cent for the Schuylkill region.

TABLE 7A.—*Anthracite shipped from the Lehigh, Schuylkill, and Wyoming regions, 1807–1928*

[Detailed figures for each year of the period 1820 to 1922 will be found in Coal in 1924, pp. 570–571. Beginning with 1914 the figures in this series include dredge shipments. Note, however, that Sullivan County is not included, because no record of it is available prior to 1890]

Year	Lehigh region		Schuylkill region		Wyoming region		Total (gross tons)
	Gross tons	Percentage	Gross tons	Percentage	Gross tons	Percentage	
1807	----------	----------	----------	----------	55	----------	55
1820	365	----------	----------	----------	----------	----------	365
1830	41, 750	23. 9	89, 984	51. 5	43, 000	24. 6	174, 734
1840	225, 313	26. 1	490, 596	56. 7	148, 470	17. 2	864, 379
1850	690, 456	20. 6	1, 840, 620	54. 8	827, 823	24. 6	3, 358, 899
1860	1, 821, 674	21. 4	3, 749, 632	44. 0	2, 941, 817	34. 6	8, 513, 123
1870	3, 239, 374	20. 0	4, 968, 157	30. 7	7, 974, 660	49. 3	16, 182, 191
1880	4, 463, 221	19. 0	7, 554, 742	32. 3	11, 419, 279	48. 7	23, 437, 242
1890	6, 329, 658	17. 3	10, 867, 822	29. 7	19, 417, 979	53. 0	36, 615, 459
1900	6, 918, 627	15. 3	13, 502, 732	30. 0	24, 686, 125	54. 7	45, 107, 484
1910	8, 627, 539	13. 3	17, 845, 020	27. 5	38, 433, 227	59. 2	64, 905, 786
1920	9, 939, 241	14. 6	20, 733, 428	30. 4	37, 517, 036	55. 0	68, 189, 705
1923	10, 154, 616	13. 9	22, 214, 576	30. 4	40, 777, 698	55. 7	73, 146, 890
1924	9, 288, 543	13. 5	19, 607, 200	28. 5	39, 917, 803	58. 0	68, 813, 546
1925	6, 719, 060	14. 0	13, 954, 495	29. 1	27, 229, 261	56. 9	47, 902, 816
1926	9, 398, 932	14. 0	18, 934, 971	28. 3	38, 709, 086	57. 7	67, 042, 989
1927	8, 778, 802	14. 0	18, 866, 778	30. 0	35, 178, 302	56. 0	62, 823, 882
1928	7, 945, 048	13. 4	18, 085, 378	30. 5	33, 226, 319	56. 1	59, 256, 745

PRODUCTION, BY FIELDS AND COUNTIES

The classification by trade regions—Lehigh, Schuylkill, and Wyoming—is the one most commonly used by the trade. It is paralleled by the organization of the United Mine Workers, in which district No. 1 corresponds to the Wyoming trade region, district No. 7 to the Lehigh region, and district No. 9 to the Schuylkill region. In studies of costs of production and reserves, however, a classification adopted by geologists is more useful because it corresponds more closely to the natural conditions that largely govern mining costs. The geologic classification recognizes four fields—the Northern, Eastern Middle, Western Middle, and Southern. The Northern field is identical with the Wyoming region. That part of the Southern field lying east of Tamaqua, known as the Panther Creek Valley, together with the Eastern Middle field, make up the Lehigh region. The part of the Southern field west of Tamaqua and the Western Middle field are together equivalent to the Schuylkill region. The Bernice Basin in Sullivan County is sometimes grouped with the Northern field.

Varying geological conditions among the four fields affect output per man, cost of mining, and the proportion of larger sizes obtained. In 1928 the output of deep-mined coal produced per man per day in the Northern field was 2.18 gross tons, in comparison with 2.56 tons in the Southern field. In the latter, however, only 58.4 per cent of the daily output consisted of the domestic sizes, upon which the industry depends for profit, in contrast to 75.4 per cent in the Northern field. Hence, natural conditions affect the value of the product as well as productivity. (For a more detailed explanation see Coal in 1927, p. 487.) For all the fields combined the daily output of deep-mined coal produced per man underground increased from 2.25 gross tons in 1926 to 2.32 tons in 1928, a gain of 3.1 per cent over the three years. (See Table 8A.)

TABLE 8A.—*Daily output of deep-mined anthracite per man underground and per cent of domestic sizes in breaker shipments, by fields, 1927 and 1928*

Field	1927		1928	
	Gross tons of deep-mined coal produced per man underground per day [1]	Per cent of domestic sizes in breaker shipments	Gross tons of deep-mined coal produced per man underground per day [1]	Per cent of domestic sizes in breaker shipments
Northern	2.20	76.0	2.18	75.4
Eastern Middle	2.38	71.4	2.54	73.3
Western Middle	2.39	68.3	2.50	67.7
Southern	2.58	56.5	2.56	58.4
Average	2.30	71.2	2.32	71.2

[1] Excluding culm-bank and strip-pit coal. In 1926 the corresponding figures were: Northern, 2.20; Eastern Middle, 2.34; Western Middle, 2.30; and Southern, 2.42.

Table 9A gives details of production in each field from 1919 through 1928.

TABLE 9A.—*Anthracite produced, by fields, 1919–1928, in gross tons*

[The figures of breaker product include a certain quantity of culm-bank coal, which in 1928 amounted to about 684,000 tons. Data for 1913–1918 will be found in Coal in 1925, p. 517]

Year	Northern field[1]				Eastern Middle field			Western Middle field			
	Breakers	Washeries	Dredges	Total	Breakers	Washeries	Total	Breakers	Washeries	Dredges	Total
1919	41,650,000	1,801,000	18,000	43,469,000	7,284,000	288,000	7,572,000	14,983,000	871,000	247,000	16,101,000
1920	40,398,000	2,939,000	29,000	43,366,000	7,010,000	115,000	7,125,000	16,123,000	942,000	240,000	17,305,000
1921	44,629,000	920,000	35,000	45,584,000	6,862,000	78,000	6,940,000	16,674,000	319,000	199,000	17,192,000
1922	24,971,000	1,032,000	48,000	26,051,000	4,121,000	36,000	4,157,000	9,651,000	995,000	194,000	10,840,000
1923	43,804,000	1,859,000	28,000	45,691,000	7,039,000	122,000	7,161,000	16,548,000	1,019,000	194,000	17,761,000
1924	44,071,000	552,000	14,000	44,637,000	6,808,000	6,000	6,814,000	15,136,000	423,000	204,000	15,763,000
1925	30,184,000	359,000	78,000	30,621,000	4,909,000	----------	4,909,000	10,633,000	334,000	248,000	11,215,000
1926	42,290,000	701,000	16,000	43,007,000	6,446,000	18,000	6,464,000	14,483,000	441,000	255,000	15,179,000
1927	38,874,000	557,000	----------	39,431,000	6,178,000	----------	6,178,000	13,673,000	832,000	351,000	14,856,000
1928	36,772,000	465,000	----------	37,237,000	5,827,000	----------	5,827,000	12,908,000	651,000	361,000	13,920,000

Year	Southern field				Total			
	Breakers	Washeries	Dredges	Total	Breakers	Washeries	Dredges	Total
1919	10,245,000	913,000	354,000	11,512,000	74,162,000	3,873,000	619,000	78,654,000
1920	10,137,000	1,673,000	392,000	12,202,000	73,668,000	5,669,000	661,000	79,998,000
1921	10,341,000	400,000	323,000	11,064,000	78,507,000	1,717,000	556,000	80,780,000
1922	6,331,000	880,000	565,000	7,776,000	45,074,000	2,943,000	807,000	48,824,000
1923	11,077,000	1,016,000	632,000	12,725,000	78,468,000	4,016,000	854,000	83,338,000
1924	10,654,000	119,000	519,000	11,292,000	76,669,000	1,100,000	737,000	78,506,000
1925	7,639,000	229,000	581,000	8,449,000	53,365,000	922,000	907,000	55,194,000
1926	10,157,000	38,000	546,000	10,741,000	73,376,000	1,198,000	817,000	75,391,000
1927	10,415,000	117,000	517,000	11,049,000	69,140,000	1,506,000	868,000	71,514,000
1928	9,595,000	215,000	481,000	10,291,000	65,102,000	1,331,000	842,000	67,275,000

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[1] Includes Sullivan County, which in 1928 contributed 138,000 tons of breaker product.

Production and value are given by counties in Table 10A for those who may be interested in segregation of the data according to local political units. In 1928, 26,352,000 tons, or slightly more than a third of the total output, came from Luzerne County, as against 16,341,000 tons for Schuylkill County and 14,596,000 tons for Lackawanna County. Only three other counties, Carbon, Dauphin, and Northumberland, produced more than 1,000,000 tons. Including the output of mines, washeries, and dredges, anthracite was produced in 19 counties in Pennsylvania. Actual mining, however, was carried on in only 10 counties, and 3 of these produced 85.2 per cent of the total supply in 1928.

TABLE 10A.—*Anthracite produced, by counties, 1927 and 1928*

County	Shipments		Local sales		Colliery fuel		Total	
	Gross tons	Value [1]	Gross tons	Value	Gross tons	Value	Gross tons	Value [1]
1927								
Carbon	2, 097, 000	$11, 686, 000	44, 000	$283, 000	90, 000	$269, 000	2, 231, 000	$12, 238, 000
Columbia	497, 000	2, 888, 000	32, 000	88, 000	61, 000	33, 000	590, 000	3, 009, 000
Dauphin	845, 000	4, 870, 000	271, 000	407, 000	119, 000	53, 000	1, 235, 000	5, 330, 000
Lackawanna	13, 711, 000	91, 611, 000	411, 000	2, 562, 000	837, 000	1, 113, 000	14, 959, 000	95, 286, 000
Luzerne	24, 743, 000	168, 621, 000	1, 231, 000	6, 265, 000	2, 328, 000	3, 456, 000	28, 302, 000	178, 342, 000
Northumberland	5, 528, 000	31, 277, 000	211, 000	1, 107, 000	594, 000	240, 000	6, 333, 000	32, 624, 000
Schuylkill	14, 660, 000	85, 636, 000	438, 000	2, 580, 000	1, 747, 000	1, 008, 000	16, 845, 000	89, 224, 000
Sullivan	118, 000	552, 000	7, 000	46, 000	27, 000	40, 000	152, 000	638, 000
Susquehanna and Wayne	583, 000	3, 831, 000	16, 000	100, 000	48, 000	63, 000	647, 000	3, 994, 000
Berks, Cumberland, Lancaster, Montour, Northampton, and York [2]	160, 000	175, 000	60, 000	82, 000			220, 000	257, 000
	62, 942, 000	401, 147, 000	2, 721, 000	13, 520, 000	5, 851, 000	6, 275, 000	71, 514, 000	420, 942, 000
1928								
Carbon	1, 581, 000	8, 696, 000	38, 000	252, 000	80, 000	234, 000	1, 699, 000	9, 182, 000
Columbia	393, 000	1, 978, 000	34, 000	76, 000	56, 000	98, 000	483, 000	2, 152, 000
Dauphin	690, 000	3, 884, 000	221, 000	351, 000	121, 000	213, 000	1, 032, 000	4, 448, 000
Lackawanna	13, 262, 000	86, 928, 000	577, 000	3, 435, 000	757, 000	1, 095, 000	14, 596, 000	91, 458, 000
Luzerne	23, 194, 000	154, 900, 000	1, 212, 000	6, 211, 000	1, 946, 000	3, 123, 000	26, 352, 000	164, 234, 000
Northumberland	5, 221, 000	28, 292, 000	203, 000	1, 006, 000	540, 000	931, 000	5, 964, 000	30, 229, 000
Schuylkill	14, 369, 000	83, 040, 000	464, 000	2, 585, 000	1, 508, 000	2, 751, 000	16, 341, 000	88, 376, 000
Sullivan	107, 000	545, 000	7, 000	47, 000	24, 000	42, 000	138, 000	634, 000
Susquehanna and Wayne	404, 000	2, 511, 000	15, 000	94, 000	35, 000	50, 000	454, 000	2, 655, 000
Berks, Cumberland, Lancaster, Lebanon, Lehigh, Montour, Northampton, Snyder, and York [2]	143, 000	159, 000	72, 000	110, 000	1, 000	1, 000	216, 000	270, 000
	59, 364, 000	370, 933, 000	2, 843, 000	14, 167, 000	5, 068, 000	8, 538, 000	67, 275, 000	393, 638, 000

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[1] Value given for shipments is value at which coal left possession of producing company f. o. b. mines and does not include margins of separately incorporated selling companies.
[2] Counties producing dredge coal only.

FRESH-MINED AND CULM-BANK COAL, BREAKER AND WASHERY PRODUCT

Reconciliation of fresh-mined, culm-bank, and breaker product.—Anthracite is now produced from three sources—from mines, from old culm banks, and from the rivers that drain the anthracite region. As all three sources contribute to the country's supply, it is important to cover them all in order to ascertain the total production. A full explanation of the method used in reconciling figures on production from the three sources is given in Coal in 1926, pages 562 and 563. No difficulty is experienced in separating the figures of production by dredges. Between the fresh-mined and the culm-bank coal, however, it is difficult to draw a sharp line that can be maintained throughout the statistics of the industry.

As the best solution of this problem the individual breaker, washery, or dredge is taken as the unit in compiling the statistics. The producing companies are asked to supply separate statements for each breaker, washery, or dredge, and these are totaled to form the primary tables of this report in order to show the total quantity of "breaker product," "washery product," and "dredge product," with related figures of value, number of employees, and time worked.

The figures of breaker and washery product, however, are not exactly equivalent to the fresh-mined and culm-bank coal because of the practice sometimes adopted of putting culm-bank coal through a breaker, either directly from the bank or after preliminary treatment in a washery. To obtain accurate statistics of the culm-bank coal, each company is now asked to recapitulate its total production of fresh-mined and culm-bank coal. The results are shown in Table 11A.

TABLE 11A.—*Comparison of anthracite production in 1923–1928 classified as fresh-mined, culm-bank, and river coal and as breaker, washery, and dredge product, in gross tons*

Data in this form were not collected prior to 1923. See Coal in 1923, pp. 697–700, for interpretation of the records of fresh-mined and washery coal before that year]

	Classified by source of coal	Classified by type of preparation plant	Difference
1923			
Fresh-mined coal	76,135,538		+2,332,837
Breaker product		78,468,375	
Culm-bank coal	[1] 6,348,963		−2,332,837
Washery product		4,016,126	
River coal	853,900		
Dredge product		853,900	
	83,338,401	83,338,401	
1924			
Fresh-mined coal	75,656,355		+1,013,000
Breaker product		76,669,355	
Culm-bank coal	[1] 2,112,813		−1,013,000
Washery product		1,099,813	
River coal	736,959		
Dredge product		736,959	
	78,506,127	78,506,127	
1925			
Fresh-mined coal	52,437,725		+927,000
Breaker product		53,364,725	
Culm-bank coal	[1] 1,849,276		−927,000
Washery product		922,276	
River coal	906,882		
Dredge product		906,882	
	55,193,883	55,193,883	

[1] Includes about 2,300,000 tons of coal put through the breakers in 1923, 1,013,000 tons in 1924, and 927,000 tons in 1925.

TABLE 11A.—*Comparison of anthracite production in 1923–1928 classified as fresh-mined, culm-bank, and river coal and as breaker, washery, and dredge product, in gross tons*—Continued

	Classified by source of coal	Classified by type of preparation plant	Difference
1926			
Fresh-mined coal	71,839,920		+1,536,000
Breaker product		73,375,920	
Culm-bank coal	[2] 2,733,908		−1,536,000
Washery product		1,197,908	
River coal	816,754		
Dredge product		816,754	
	75,390,582	75,390,582	
1927			
Fresh-mined coal	67,688,369		+1,452,000
Breaker product		69,140,369	
Culm-bank coal	[2] 2,957,833		−1,452,000
Washery product		1,505,833	
River coal	867,694		
Dredge product		867,694	
	71,513,896	71,513,896	
1928			
Fresh-mined coal	64,417,666		+684,000
Breaker product		65,101,666	
Culm-bank coal	[2] 2,015,074		−684,000
Washery product		1,331,074	
River coal	842,322		
Dredge product		842,322	
	67,275,062	67,275,062	

[2] Includes about 1,536,000 tons of coal put through the breakers in 1926, 1,452,000 tons in 1927, and 684,000 tons in 1928.

In 1928 out of 65,101,666 tons handled by breakers 684,000 tons was culm-bank coal. The fresh-mined coal proper was 64,417,666 tons. The quantity handled by washeries was 1,331,074 tons, but including the 684,000 tons of bank coal run through breakers the total produced from culm banks was 2,015,074 tons.

Culm-bank coal.—In the past five years there has been a downward trend in the quantity of culm-bank coal recovered. In comparison with the 6,348,963 tons recovered from the banks in 1923 the total for 1927 showed a decrease of 53.4 per cent and the total for 1928 a decrease of 68.3 per cent. As seen from Table 12A, the practice of treating culm-bank coal in breakers is commonest in the Western Middle and Southern fields.

TABLE 12A.—*Culm-bank coal put through breakers, by fields, 1924–1928, in gross tons*

Year	Northern	Eastern Middle	Western Middle	Southern	Total
1924	170,000	220,000	386,000	237,000	1,013,000
1925	173,000	181,000	396,000	177,000	927,000
1926	271,000	230,000	542,000	493,000	1,536,000
1927	313,000	273,000	333,000	533,000	1,452,000
1928	77,000	87,000	279,000	241,000	684,000

Anthracite shipped from breakers, washeries, and dredges since 1890.—By limiting the comparison to shipments the relative growth of breaker, washery, and dredge operations since 1890 can be shown. (Table 13A.)

TABLE 13A.—*Anthracite shipped from breakers, washeries, and dredges, 1890–1928, in gross tons*

[Includes shipments for Sullivan County, except for 1895, for which no data are available. Detailed figures for each year of the period up to 1924 will be found in Coal in 1924, p. 574]

Year	Breakers [1]	Washeries [1]	Dredges	Total
1890	36,573,000	42,000	-------------	36,615,000
1895	45,430,000	1,081,000	-------------	46,511,000
1900	43,218,000	2,059,000	-------------	45,277,000
1905	59,010,000	2,644,000	-------------	61,654,000
1910	62,417,000	3,296,000	22,000	65,735,000
1915	66,174,000	2,475,000	17,000	68,666,000
1917	72,077,000	5,366,000	47,000	77,490,000
1918	70,090,000	6,506,000	125,000	76,721,000
1919	64,632,000	3,017,000	323,000	67,972,000
1920	63,599,000	4,616,000	396,000	68,611,000
1921	67,981,000	1,308,000	265,000	69,554,000
1922	37,907,000	2,600,000	567,000	41,074,000
1923	69,289,000	3,754,000	385,000	73,428,000
1924	67,592,000	1,060,000	319,000	68,971,000
1925	46,615,000	872,000	520,000	48,007,000
1926	65,826,000	1,068,000	355,000	67,249,000
1927	61,130,000	1,317,000	495,000	62,942,000
1928	57,636,000	1,245,000	483,000	59,364,000

[1] In recent years a considerable tonnage of culm-bank coal has been handled in the breakers, so that the figures of shipments from washeries are less than the sales of culm-bank coal.

DETAILS OF SHIPMENTS, BY REGIONS AND SIZES

TABLE 14A.—*Anthracite shipped, by regions and sizes, 1927 and 1928, in gross tons*

[The figures of shipments from breakers include a considerable tonnage of culm-bank coal handled in the breakers]

Size	Breaker shipments					Washery shipments	Dredge shipments	Grand total
	Lehigh region	Schuylkill region	Wyoming region	Sullivan County	Total			
1927								
Broken and lump [1]	34,236	138,707	438,443	([2])	611,386	([2])	--------	611,386
Egg	673,157	1,731,407	4,703,764	[2] 5,798	7,114,126	[2] 7,596	--------	7,121,722
Stove	2,022,548	3,820,266	9,980,305	21,460	15,844,579	33,467	--------	15,878,046
Chestnut	2,255,108	4,381,279	9,502,847	22,995	16,162,229	88,110	--------	16,250,339
Pea	681,878	1,265,207	1,823,142	10,254	3,780,481	107,185	([3])	3,887,666
Total domestic	5,666,927	11,336,866	26,448,501	60,507	43,512,801	236,358	([3])	43,749,159
Buckwheat No. 1	1,107,964	2,643,590	4,089,100	--------	7,840,654	248,881	[3] 2,409	8,091,944
Buckwheat No. 2 (rice)	732,357	1,438,235	2,472,765	--------	4,643,357	379,797	([3])	5,023,154
Buckwheat No. 3 (barley)	943,595	1,855,439	1,417,274	--------	4,216,308	426,447	214,264	4,857,019
Boiler	--------	8,274	47,028	--------	55,302	--------	([4])	55,302
Other [5]	251,908	267,092	284,691	57,831	861,522	26,140	[4] 277,980	1,165,642
Total steam	3,035,824	6,212,630	8,310,858	57,831	17,617,143	1,081,265	494,653	19,193,061
Grand total	8,702,751	17,549,496	34,759,359	118,338	61,129,944	1,317,623	494,653	62,942,220
1928								
Broken	18,785	113,195	250,035	--------	382,015	--------	--------	382,015
Egg	625,746	1,498,261	4,619,295	4,338	6,747,640	844	--------	6,748,484
Stove	1,862,280	3,785,452	9,091,430	19,824	14,758,986	19,426	--------	14,778,412
Chestnut	2,092,083	4,055,613	8,489,278	25,303	14,662,277	98,568	--------	14,760,845
Pea	725,231	1,453,715	2,316,486	8,369	4,503,801	92,874	--------	4,596,675
Total domestic	5,324,125	10,906,236	24,766,524	57,834	41,054,719	211,712	--------	41,266,431
Buckwheat No. 1	1,054,588	2,637,767	3,910,190	--------	7,602,545	227,744	([6])	7,830,289
Buckwheat No. 2 (rice)	665,029	1,267,060	2,552,919	--------	4,485,008	302,052	[6] 12,818	4,799,878
Buckwheat No. 3 (barley)	740,837	1,784,232	1,417,490	--------	3,942,559	438,139	304,372	4,685,070
Boiler	--------	7,132	21,736	([4])	28,868	--------	56,439	85,307
Other [5]	80,733	250,640	141,084	[4] 49,350	521,807	65,545	109,602	696,954
Total steam	2,541,187	5,946,831	8,043,419	49,350	16,580,787	1,033,480	483,231	18,097,498
Grand total	7,865,312	16,853,067	32,809,943	107,184	57,635,506	1,245,192	483,231	59,363,929

[1] The quantity of lump included is insignificant.
[2] A small amount of broken coal is included with egg.
[3] A small amount of pea and buckwheat No. 2 is included with buckwheat No. 1.
[4] A small amount of boiler coal is included with "Other."
[5] Includes buckwheat No. 4, silt, culm, screenings, mine-run coal, slush, and unsized coal smaller than pea.
[6] A small amount of buckwheat No. 1 is included with buckwheat No. 2.

TABLE 15A.—*Value of anthracite shipped, by regions and sizes, 1927 and 1928*[1]

Size	Breaker shipments										Washery shipments		Dredge shipments		Grand total	
	Lehigh region		Schuylkill region		Wyoming region		Sullivan County		Total							
	Total	Average per ton	Total	Average per ton	Total	Average per ton	Total	Average per ton	Total	Average per ton	Total	Average per ton	Total	Average per ton	Total	Average per ton
1927																
Broken and lump[2]	$283, 705	$8. 29	$1, 231, 670	$8. 88	$3, 482, 458	$7. 94	(3)	(3)	$4, 997, 833	$8. 17	(3)	(3)	----------	-------	$4, 997, 833	$8. 17
Egg	5, 707, 367	8. 48	14, 583, 218	8. 42	39, 086, 361	8. 31	[3] $49, 037	[3] $8. 46	59, 425, 983	8. 35	[3] $64, 626	[3] $8. 51	----------	-------	59, 490, 609	8. 35
Stove	18, 156, 999	8. 98	34, 390, 868	9. 00	87, 611, 478	8. 78	182, 437	8. 50	140, 341, 782	8. 86	265, 853	7. 94	----------	-------	140, 607, 635	8. 86
Chestnut	19, 073, 371	8. 46	37, 153, 892	8. 48	78, 976, 293	8. 31	195, 048	8. 48	135, 398, 604	8. 38	667, 554	7. 58	----------	-------	136, 066, 158	8. 37
Pea	4, 102, 907	6. 02	7, 505, 912	5. 93	10, 622, 426	5. 83	55, 063	5. 37	22, 286, 308	5. 90	601, 715	5. 61	(4)	(4)	22, 888, 023	5. 89
Total domestic	47, 324, 349	8. 35	94, 865, 560	8. 37	219, 779, 016	8. 31	481, 585	7. 96	362, 450, 510	8. 33	1, 599, 748	6. 77	(4)	(4)	364, 050, 258	8. 32
Buckwheat No. 1	2, 806, 022	2. 53	6, 583, 858	2. 49	10, 686, 720	2. 61	----------	-------	20, 076, 600	2. 56	618, 980	2. 49	[4] $4, 859	[4] $2. 02	20, 700, 439	2. 56
Buckwheat No. 2 (rice)	1, 397, 582	1. 91	2, 377, 295	1. 65	4, 492, 932	1. 82	----------	-------	8, 267, 809	1. 78	649, 443	1. 71	(4)	(4)	8, 917, 252	1. 78
Buckwheat No. 3 (barley)	1, 318, 479	1. 40	2, 319, 540	1. 25	1, 936, 137	1. 37	----------	-------	5, 574, 156	1. 32	555, 294	1. 30	172, 282	. 80	6, 301, 732	1. 30
Boiler	----------	-------	2, 407	. 29	69, 105	1. 47	----------	-------	71, 512	1. 29	----------	-------	(5)	(5)	71, 512	1. 29
Other	116, 048	. 46	144, 956	. 54	509, 239	1. 79	70, 654	1. 22	840, 897	. 98	15, 440	. 59	[5] 249, 096	[5] . 90	1, 105, 433	. 95
Total steam	5, 638, 131	1. 86	11, 428, 056	1. 84	17, 694, 133	2. 13	70, 654	1. 22	34, 830, 974	1. 98	1, 839, 157	1. 70	426, 237	. 86	37, 096, 368	1. 93
Grand total	52, 962, 480	6. 09	106, 293, 616	6. 06	237, 473, 149	6. 83	552, 239	4. 67	397, 281, 484	6. 50	3, 438, 905	2. 61	426, 237	. 86	401, 146, 626	6. 37
1928																
Broken	151, 001	8. 04	971, 462	8. 58	1, 972, 947	7. 89	----------	-------	3, 095, 410	8. 10	----------	-------	----------	-------	3, 095, 410	8. 10
Egg	5, 221, 968	8. 35	12, 554, 657	8. 38	38, 364, 872	8. 31	36, 702	8. 46	56, 178, 199	8. 33	7, 119	8. 43	----------	-------	56, 185, 318	8. 33
Stove	16, 295, 512	8. 75	33, 336, 854	8. 81	78, 922, 665	8. 68	168, 380	8. 49	128, 723, 411	8. 72	138, 832	7. 15	----------	-------	128, 862, 243	8. 72
Chestnut	17, 405, 264	8. 32	33, 985, 314	8. 38	70, 232, 543	8. 27	212, 136	8. 38	121, 835, 257	8. 31	647, 059	6. 56	----------	-------	122, 482, 316	8. 30
Pea	3, 630, 789	5. 01	7, 212, 148	4. 96	11, 614, 254	5. 01	42, 255	5. 05	22, 499, 446	5. 00	421, 286	4. 54	----------	-------	22, 920, 732	4. 99
Total domestic	42, 704, 534	8. 02	88, 060, 435	8. 07	201, 107, 281	8. 12	459, 473	7. 94	332, 331, 723	8. 09	1, 214, 296	5. 74	----------	-------	333, 546, 019	8. 08

Buckwheat No. 1	2,880,065	2.73	6,987,417	2.65	11,028,920	2.82	----------	-------	20,896,402	2.75	597,545	2.62	(6)	(6)	21,493,947	2.74
Buckwheat No. 2 (rice)	1,267,115	1.91	2,240,190	1.77	4,790,194	1.88	----------	-------	8,297,499	1.85	540,437	1.79	[6]12,374	[6].97	8,850,310	1.84
Buckwheat No. 3 (barley)	1,034,694	1.40	2,432,640	1.36	1,989,737	1.40	----------	-------	5,457,071	1.38	600,528	1.37	263,546	.87	6,321,145	1.35
Boiler	----------	-------	2,885	.40	25,090	1.15	(5)	(5)	27,975	.97	----------	-------	64,033	1.13	92,008	1.08
Other	35,659	.44	167,515	.67	210,472	1.49	[5]85,410	[5]1.73	499,056	.96	44,782	.68	85,528	.78	629,366	.90
Total steam	5,217,533	2.05	11,830,647	1.99	18,044,413	2.24	85,410	1.73	35,178,003	2.12	1,783,292	1.73	425,481	.88	37,386,776	2.07
Grand total	47,922,067	6.09	99,891,082	5.93	219,151,694	6.68	544,883	5.08	367,509,726	6.38	2,997,588	2.41	425,481	.88	370,932,795	6.25

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[1] Value given is value at which coal left possession of producing company f. o. b. mines and does not include margins of separately incorporated selling companies.
[2] The quantity of lump included is insignificant.
[3] A small amount of broken coal is included with egg.
[4] A small amount of pea and buckwheat No. 2 is included with buckwheat No. 1.
[5] A small amount of boiler coal is included with "Other."
[6] A small amount of buckwheat No. 1 is included with buckwheat No. 2.

TRENDS IN SIZES SHIPPED

Details of the quantity and value of each size shipped in 1927 and 1928 are given by regions in Tables 14A and 15A. Table 16A shows the relative percentage of each size in the total shipments of breaker coal from 1922 to 1928.

The total shipments of steam sizes, including dredge and washery coal, declined from 19,193,061 tons in 1927 to 18,097,498 tons in 1928. Similarly, total shipments of domestic sizes decreased from 43,749,159 to 41,266,431 tons over the two years.

Within the group of domestic sizes the relative proportions of each size are affected by changes in the standards of sizing that have been made from time to time. In view of certain revisions undertaken in 1925 and the recommendation for further improvement of preparation standards in 1928, special interest attaches to a comparison between the relative proportions of the five principal domestic sizes in 1928 and those in four preceding years. The following figures, abstracted from Table 16A, represent percentages of the total breaker shipments for the year:

	1923	1924	1926	1927	1928
Broken	5.0	2.7	1.6	1.0	0.7
Egg	15.7	14.5	13.5	11.7	11.7
Stove	19.6	22.2	25.1	25.9	25.6
Chestnut	25.6	26.5	27.1	26.4	25.4
Pea	8.0	8.3	5.5	6.2	7.8

TABLE 16A.—*Sizes of anthracite shipped from breakers, by regions, 1922–1928, in per cent of total*

[Note that shipments of dredge and washery coal are not included]

Region and size of coal	Percentage of total shipments						
	1922	1923	1924	1925	1926	1927	1928
Lehigh:							
Lump	-------	-------	-------	-------	(1)	(2)	-------
Broken	1.8	1.7	1.0	1.1	0.5	[2] 0.4	0.2
Egg	12.7	14.7	13.1	11.5	9.3	7.8	8.0
Stove	18.8	17.8	19.6	22.0	21.9	23.2	23.7
Chestnut	25.3	25.4	26.1	26.9	25.8	25.9	26.6
Pea	11.3	9.6	9.5	7.4	7.5	7.9	9.2
Total domestic	69.9	69.2	69.3	68.9	65.0	65.2	67.7
Buckwheat No. 1	14.7	14.3	13.7	12.8	11.7	12.7	13.4
Buckwheat No. 2 (rice)	7.8	7.4	7.1	7.6	7.3	8.4	8.5
Buckwheat No. 3 (barley)	6.7	7.7	8.7	8.6	10.7	10.8	9.4
Boiler	.2	.2	(1)	(1)	2.0	-------	-------
Other	.7	1.2	1.2	2.1	3.3	2.9	1.0
Total steam	30.1	30.8	30.7	31.1	35.0	34.8	32.3
Schuylkill:							
Lump	(1)	.1	.1	(1)	(1)	(2)	-------
Broken	3.5	3.5	1.7	1.5	.9	[2] .8	0.6
Egg	11.3	12.5	11.6	10.0	10.4	9.9	8.9
Stove	20.0	18.0	20.6	22.3	23.5	21.8	22.5
Chestnut	[3] 25.0	23.3	24.3	24.9	26.0	25.0	24.1
Pea	8.9	10.0	10.1	7.5	7.3	7.2	8.6
Total domestic	68.7	67.4	68.4	66.2	68.1	64.7	64.7

[1] Less than one-tenth of 1 per cent.
[2] A small amount of lump coal is included with broken.
[3] Includes range coal.

TABLE 16A.—*Sizes of anthracite shipped from breakers, by regions, 1922–1928, in per cent of total*—Continued

Region and size of coal	Percentage of total shipments						
	1922	1923	1924	1925	1926	1927	1928
Schuylkill—Continued.							
Buckwheat No. 1	16.2	16.9	15.4	14.4	12.8	15.0	15.7
Buckwheat No. 2 (rice)	6.2	6.4	5.7	7.9	8.1	8.2	7.5
Buckwheat No. 3 (barley)	7.8	8.5	9.8	10.5	9.9	10.6	10.6
Boiler	.2	(1)	(1)	(1)	.1	(1)	(1)
Other	.9	.8	.7	1.0	1.0	1.5	1.5
Total steam	31.3	32.6	31.6	33.8	31.9	35.3	35.3
Wyoming:							
Lump	--------	--------	--------	--------	--------	--------	--------
Broken	5.3	6.6	3.6	3.6	2.2	1.3	.7
Egg	16.6	17.7	16.2	15.8	16.0	13.5	14.1
Stove	23.1	20.9	23.5	25.9	26.7	28.7	27.7
Chestnut	[3]26.5	[3]26.8	[3]27.8	[3]27.6	[3]27.9	27.3	25.9
Pea	6.4	6.5	7.1	4.2	4.1	5.3	7.1
Total domestic	77.9	78.5	78.2	77.1	76.9	76.1	75.5
Buckwheat No. 1	11.2	10.6	10.5	11.3	10.8	11.8	11.9
Buckwheat No. 2 (rice)	6.5	6.5	6.7	7.2	7.5	7.1	7.8
Buckwheat No. 3 (barley)	3.5	3.8	3.8	3.6	3.9	4.1	4.3
Boiler	.4	.2	.2	.1	.2	.1	.1
Other	.5	.4	.6	.7	.7	.8	.4
Total steam	22.1	21.5	21.8	22.9	23.1	23.9	24.5
Sullivan County:							
Lump	--------	--------	--------	--------	--------	--------	--------
Broken	4.2	5.0	.1	.4	1.9	(4)	--------
Egg	6.4	10.0	7.7	8.8	9.2	[4]4.9	4.1
Stove	9.9	16.4	14.5	17.1	19.1	18.1	18.5
Chestnut	15.4	21.8	18.6	22.3	23.3	19.4	23.6
Pea	9.1	15.8	9.6	11.5	12.4	8.7	7.8
Total domestic	45.0	69.0	50.5	60.1	65.9	51.1	54.0
Boiler, screenings, etc	55.0	31.0	49.5	39.9	34.1	48.9	46.0
Grand total:							
Lump	(1)	(1)	(1)	(1)	(1)	(2)	--------
Broken	4.3	5.0	2.7	2.6	1.6	[2]1.0	.7
Egg	14.5	15.7	14.5	13.5	13.5	11.7	11.7
Stove	21.5	19.6	22.2	24.4	25.1	25.9	25.6
Chestnut	[3]25.8	[3]25.6	[3]26.5	[3]26.8	[3]27.1	26.4	25.4
Pea	7.8	8.0	8.3	5.6	5.5	6.2	7.8
Total domestic	73.9	73.9	74.2	72.9	72.8	71.2	71.2
Buckwheat No. 1	13.0	12.9	12.3	12.4	11.4	12.8	13.2
Buckwheat No. 2 (rice)	6.6	6.6	6.5	7.4	7.6	7.6	7.8
Buckwheat No. 3 (barley)	5.2	5.7	6.1	6.2	6.5	6.9	6.8
Boiler	.3	.2	.1	.1	.5	.1	.1
Other	1.0	.7	.8	1.0	1.2	1.4	.9
Total steam	26.1	26.1	25.8	27.1	27.2	28.8	28.8

[1] Less than one-tenth of 1 per cent.
[2] A small amount of lump coal is included with broken.
[3] Includes range coal.
[4] A small amount of broken coal is included with egg.

A summary of shipments by sizes for the last decade is given in Table 17A. In comparison with 1927, the percentage of pea in breaker shipments in 1928 increased, the percentage of sizes above pea declined, and the percentage of sizes below pea was exactly the same. As in total shipments, which include dredge and washery coal, the smaller proportion of sizes above pea in comparison with 1927 is entirely accounted for by the gain in the percentage of pea. For the past two years the proportion of steam sizes both in breaker and in total shipments has remained the same.

TABLE 17A.—*Shipments of anthracite from breakers and total from all operations, classified by sizes, 1919–1928*

[A table separating shipments of domestic sizes from pea and steam for each year from 1890 to 1924, excluding, however, Sullivan County and dredge coal, will be found in Coal in 1924, p. 575]

	Sizes above pea		Pea		Sizes below pea		Total (gross tons)
	Gross tons	Percentage of total	Gross tons	Percentage of total	Gross tons	Percentage of total	
Breaker product:							
1919	42, 937, 454	66. 4	5, 884, 492	9. 1	15, 809, 757	24. 5	64, 631, 703
1920	42, 209, 170	66. 4	5, 008, 050	7. 9	16, 381, 463	25. 7	63, 598, 683
1921	45, 796, 115	67. 4	5, 720, 904	8. 4	16, 464, 397	24. 2	67, 981, 416
1922	25, 046, 679	66. 1	2, 967, 355	7. 8	9, 892, 469	26. 1	37, 906, 503
1923	45, 651, 693	65. 9	5, 544, 915	8. 0	18, 091, 818	26. 1	69, 288, 426
1924	44, 566, 747	65. 9	5, 593, 926	8. 3	17, 431, 597	25. 8	67, 592, 270
1925	31, 359, 250	67. 3	2, 608, 744	5. 6	12, 647, 429	27. 1	46, 615, 423
1926	44, 301, 428	67. 3	3, 636, 137	5. 5	17, 888, 624	27. 2	65, 826, 189
1927	39, 732, 320	65. 0	3, 780, 481	6. 2	17, 617, 143	28. 8	61, 129, 944
1928	36, 550, 918	63. 4	4, 503, 801	7. 8	16, 580, 787	28. 8	57, 635, 506
Total shipments:[1]							
1919	43, 349, 551	63. 8	6, 237, 398	9. 2	18, 385, 346	27. 0	67, 972, 295
1920	42, 984, 656	62. 6	5, 457, 588	8. 0	20, 168, 519	29. 4	68, 610, 763
1921	46, 051, 199	66. 2	5, 865, 379	8. 4	17, 637, 985	25. 4	69, 554, 563
1922	25, 409, 723	61. 8	3, 278, 136	8. 0	12, 385, 979	30. 2	41, 073, 838
1923	46, 479, 297	63. 3	5, 928, 618	8. 1	21, 019, 797	28. 6	73, 427, 712
1924	44, 825, 550	65. 0	5, 689, 000	8. 2	18, 456, 431	26. 8	68, 970, 981
1925	31, 518, 719	65. 7	2, 682, 372	5. 6	13, 806, 384	28. 7	48, 007, 475
1926	44, 601, 096	66. 3	3, 699, 294	5. 5	18, 948, 556	28. 2	67, 248, 946
1927	39, 861, 493	63. 3	3, 887, 666	6. 2	19, 193, 061	30. 5	62, 942, 220
1928	36, 669, 756	61. 8	4, 596, 675	7. 7	18, 097, 498	30. 5	59, 363, 929

[1] Includes shipments of washery and dredge coal.

At this point it should be noted that the classifications used in the preceding tables are not always the same. Tables 14A, 15A, and the last half of Table 17A include all anthracite shipments. Table 16A and the first half of Table 17A include all shipments from breakers and exclude dredge and washery coal. These differences should be kept in mind when comparisons are made.

LOCAL SALES

Shipments to points outside the mining area absorb most of the production of anthracite and provide most of the industry's gross revenue, but considerable tonnages are also sold in the thriving communities within the anthracite region itself. These "local sales" (as they are designated in the tables of this report) plus the shipments constitute the commercial or revenue-producing part of the production.

In 1928 local sales were 2,843,594 tons, or 4.2 per cent of the total output, a gain of 123,264 tons over 1927. In 1913 they amounted to 1,793,814 tons; in 1919, to 2,107,876 tons; and in 1923, to 2,900,314 tons. For recent years they constitute 3 to 4 per cent of the total production, as against 2.4 per cent before the war. While the quantity of anthracite sold locally generally increased during the past 10 years, at least a part of the year-to-year fluctuations in the proportion of total output represented by local sales is explained by changes in the output. (Table 18A.)

TABLE 18A.—*Disposition of total output of anthracite, 1890–1928, in per cent*

Year	Shipments	Local sales	Colliery fuel	Year	Shipments	Local sales	Colliery fuel
1890	88. 3	4. 3	7. 4	1921	86. 1	3. 1	10. 8
1895	89. 8	2. 3	7. 9	1922	84. 1	4. 4	11. 5
1900	88. 4	2. 1	9. 5	1923	88. 1	3. 5	8. 4
1905	88. 9	2. 0	9. 1	1924	87. 8	3. 5	8. 7
1910	87. 1	2. 4	10. 5	1925	87. 0	4. 7	8. 3
1915	86. 4	2. 4	11. 2	1926	89. 2	3. 2	7. 6
1919	86. 4	2. 7	10. 9	1927	88. 0	3. 8	8. 2
1920	85. 8	3. 2	11. 0	1928	88. 3	4. 2	7. 5

To throw light on the character of the local market, the bureau addressed a supplementary inquiry to each producer of fresh-mined and culm-bank coal asking for a statement of the sizes sold locally. The data thus obtained are tabulated for the years 1926 to 1928 to show local sales of breakers and washeries and of dredges separately in Table 19A. The figures are most complete for 1928, when 96.5 per cent of the local sales by breakers and washeries and 87.6 per cent of those by dredges are accounted for.

TABLE 19A.—*Tabulation of reports of certain operators of breakers, washeries, and dredges as to the sizes of anthracite sold locally, 1926–1928*

Size	1926		1927		1928	
	Gross tons	Per cent of total	Gross tons	Per cent of total	Gross tons	Per cent of total
Breakers and washeries						
Lump	718	0.1	552	(1)	58	(1)
Broken	9,376	.7	9,918	0.5	19,923	0.8
Egg	9,271	.7	12,059	.6	15,914	.7
Stove	44,461	3.5	64,405	3.4	77,934	3.2
Chestnut	558,312	43.5	742,616	38.8	796,313	33.0
Pea	320,496	25.0	454,439	23.7	751,890	31.2
Buckwheat No. 1	158,069	12.3	236,395	12.3	349,069	14.5
Buckwheat No. 2	47,665	3.7	171,911	9.0	194,857	8.1
Buckwheat No. 3	90,170	7.0	141,507	7.4	147,603	6.1
Boiler	34,523	2.7	78,763	4.1	55,237	2.3
Other	10,344	.8	3,121	.2	2,081	.1
	1,283,405	100.0	1,915,686	100.0	2,410,879	100.0
Total local sales from breakers and washeries	1,942,947		2,351,869		2,497,709	
Percentage of total local sales accounted for, by sizes		66.1		81.5		96.5
Dredges						
Egg	88	(1)				
Stove	48	(1)	22	(1)	193	.1
Chestnut			104	(1)	644	.2
Pea	530	.1	1,099	.2	1,739	.6
Buckwheat No. 1	5,526	1.5	7,143	1.5	7,320	2.4
Buckwheat No. 2	25,037	6.7	12,186	2.6	7,406	2.5
Buckwheat No. 3	5,153	1.4	50,640	10.7	22,800	7.5
Boiler	52,711	14.1	63,140	13.3	69,499	22.9
Other [2]	285,037	76.2	340,721	71.7	193,536	63.8
	374,130	100.0	475,055	100.0	303,137	100.0
Total local sales from dredges	456,527		368,461		345,885	
Percentage of total local sales accounted for, by sizes		82.0		77.6		87.6

[1] Less than one-tenth of 1 per cent.

[2] Mainly unsized river coal.

Local sales from breakers and washeries are seen to consist largely of chestnut, pea, and buckwheat No. 1. In the total breaker and washery shipments outside the region chestnut made up 25.0 per cent in 1928, while in the local sales of companies reporting it made up 33.0 per cent. Pea made up only 7.8 per cent of the total shipments but comprised 31.2 per cent of the local sales of the companies reporting. Likewise, buckwheat No. 1, which made up 14.5 per cent of the local sales, was 13.3 per cent of the total shipments. Between 1926 and 1928 the proportion of pea in local sales by breakers and washeries increased 6.2 per cent and the proportion of buckwheat No. 1, 2.2 per cent. The large proportion of pea in the trade within the region helps to explain the lower average value of local sales as compared with the value of shipments.

In 1928, 345,885 tons, or 41.1 per cent of the total output, of dredge coal was sold locally. Steam sizes comprised all but a small part of this tonnage.

TRENDS IN VALUES AND PRICES

SOURCES OF INFORMATION AND METHODS OF ANALYSES

Margins of sales agents not included.—The valuation figures in this study represent value at the breaker or washery, as reported by the operating companies. In making its report the company is requested to "estimate value of the product not sold" and to "exclude selling expenses."

From this it will be seen that where a producing company sells its output to a separately organized sales company—the practice of many, including certain of the largest producers—the value reported will exclude the margin of the sales company and may therefore be somewhat less than the circular price at which the coal in question is placed on the general market. This fact should be borne in mind in considering the variations between different regions shown in the tables for the same sizes of coal.[48]

Estimates included in the figures of value.—The reports are furnished in writing and signed by responsible officers of the mining companies. Complete reports have been received from all operators as to tonnage produced and other points touching the physical operation of the mines. A few companies made no reply on the value of the product, however, and to round out the totals, estimates of these values have been made. The estimates represent only 11 per cent of the value shown in 1928 because aside from a few extremely small producers only one company failed to report. The values for this company, a producer in the Wyoming region, were estimated in 1928 as follows: The tonnage it reported of each size from broken to pea was multiplied by the company's average circular price for that size, as quoted in the trade journals for the year. The tonnage that it reported for buckwheat No. 1 and each smaller size was multiplied by the average sales realization obtained on that size by all other producers in the Wyoming region.

This method of computation gives results that are exactly comparable with those of 1926 and 1927, with a single exception (buckwheat No. 1 in 1926). Before 1926 a different method of computation was used. The change in method introduced a slight break in the comparability of the figures, the extent of which was fully discussed in Coal in 1926, pages 576 to 580.

AVERAGE SALES REALIZATIONS, 1921–1928

The average sales realizations on each size from 1921 to 1928 are given in Table 20A. To insure comparability, the table is based on shipments of breaker coal only, the dredge and washery product being excluded.

Further declines on domestic sizes.—Average realizations on each of the domestic sizes, which, with the exception of pea and egg, had increased from 1921 to 1926, declined noticeably in 1927 and even still further in 1928. (Table 20A.) Each of the domestic sizes shared in the drop in values in 1928, and in comparison with the preceding year reductions ranged from 2 cents a ton on egg to 90 cents a ton on pea. On all domestic sizes combined, including pea, the decrease from 1927 to 1928 was 24 cents a ton.

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[48] See Gordon, Ellery B., Distribution of Anthracite: U. S. Coal Commission Rept., 1925, pt. 2, pp. 677, 681, 682, for a statement of the marketing arrangements of the principal companies and the quantities handled through sales agents.

Prices of pea coal.—The average sales realization of pea coal in 1928 was the lowest for any year since 1919. From 1921 to 1923 pea brought increasing returns, the average receipts rising from $5.74 in 1921 to $6.18 in 1923. Thereafter prices dropped to $5.60 in 1924 and $5.27 in 1925. In the next two years sales realizations were $5.98 and $5.90, respectively, and the sharp reduction to $5 in 1928 meant a decrease of at least $3,500,000 to the industry in comparison with the average price obtained in 1927.

Increase in prices of steam sizes in 1928.—In contrast to the lower sales realizations for domestic coal average prices for each size in the steam group increased in 1928. In comparison with 1927 the gains ranged from 6 cents a ton on buckwheat No. 3 to 19 cents a ton on buckwheat No. 1. The increased prices for steam sizes in 1927 and 1928 are in distinct contrast to the steady reductions from 1922 to 1926 made in order to meet the pressure of low-price bituminous coal. Computed in a manner to be exactly comparable from year to year, the averages have been as follows:

	1921	1922	1923	1924	1925	1926	1927	1928
Buckwheat No. 1	$3.43	$3.56	$3.48	$2.94	$2.49	[1]$2.39	$2.56	$2.75
Buckwheat No. 2 (rice)	2.27	2.37	2.23	1.93	1.84	1.78	1.78	1.85
All steam sizes	2.75	2.77	2.64	2.25	2.00	[1]1.88	1.98	2.12

[1] These figures differ from the corresponding ones in Table 20A, in computing which the value of the buckwheat No. 1 shipped by one large company in the Wyoming region was taken at the company's circular price. The figures for 1926 here given are computed by taking the value of this company's tonnage at the average sales realization obtained by other shippers in the Wyoming region.

The average realization of $2.75 on buckwheat No. 1 (Table 20A) in 1928 was the highest for any year since 1924. The increase in the price of buckwheat during the past two years is in part a result of the campaign for increased use of this size in domestic heating.

Average value for all sizes.—The increase in realizations for the steam group was not enough to offset the losses on the domestic grades, and the grand average for all sizes fell from $6.50 in 1927 to $6.38 in 1928. The downward trend in average realizations during the past two years is in striking contrast to the steady increase that characterized the period from 1916 to 1923.

TABLE 20A.—*Average sales realization per gross ton on anthracite shipments from breakers, by regions and sizes, 1921–1928*

[Value does not include margins of separately incorporated sales companies]

Region and size of coal	1921	1922	1923	1924	1925	1926	1927	1928
Lehigh:								
Lump	--------	--------	--------	--------	--------	$8.60	(1)	--------
Broken	$7.51	$7.73	$8.01	$8.32	$8.04	8.39	[1]$8.29	$8.04
Egg	7.68	8.03	8.69	8.78	8.61	9.03	8.48	8.35
Stove	7.94	8.06	8.65	9.10	9.02	9.34	8.98	8.75
Chestnut	7.87	8.03	8.60	8.95	8.65	8.93	8.46	8.32
Pea	5.92	5.93	6.34	5.90	5.48	6.10	6.02	5.01
Total domestic	7.55	7.69	8.31	8.53	8.41	8.75	8.35	8.02
Buckwheat No. 1	3.49	3.66	3.60	2.96	2.53	2.38	2.53	2.73
Buckwheat No. 2 (rice)	2.40	2.55	2.49	2.08	1.92	1.85	1.91	1.91
Buckwheat No. 3 (barley)	1.54	1.75	1.55	1.48	1.45	1.40	1.40	1.40
Total steam[2]	2.66	2.86	2.70	2.25	1.95	1.72	1.86	2.05
Total, all sizes	6.20	6.23	6.58	6.61	6.40	6.29	6.09	6.09

[1] An insignificant quantity of lump is included with the broken coal.

[2] Includes all other steam sizes.

TABLE 20A.—*Average sales realization per gross ton on anthracite shipments from breakers, by regions and sizes, 1921–1928*—Continued

Region and size of coal	1921	1922	1923	1924	1925	1926	1927	1928
Schuylkill:								
Lump	$7.50	$7.70	$8.35	$5.18	$8.85	$9.32	(1)	--------
Broken	7.76	8.30	8.79	8.71	8.67	9.25	[1] $8.88	$8.58
Egg	7.63	8.12	8.85	8.75	8.62	9.04	8.42	8.38
Stove	7.81	8.27	8.87	9.16	9.06	9.36	9.00	8.81
Chestnut	7.92	[3] 8.28	8.86	9.00	8.75	9.04	8.48	8.38
Pea	5.80	6.07	6.35	5.68	5.30	6.05	5.93	4.96
Total domestic	7.52	7.97	8.49	8.50	8.45	8.83	8.37	8.07
Buckwheat No. 1	3.44	3.50	3.43	2.69	2.38	2.34	2.49	2.65
Buckwheat No. 2 (rice)	2.22	2.29	2.18	1.91	1.79	1.68	1.65	1.77
Buckwheat No. 3 (barley)	1.37	1.50	1.35	1.23	1.22	1.25	1.25	1.36
Total steam [2]	2.78	2.65	2.57	2.04	1.83	1.77	1.84	1.99
Total, all sizes	6.15	6.30	6.56	6.46	6.21	6.59	6.06	5.93
Wyoming:								
Lump	5.21	--------	--------	--------	--------	--------	--------	--------
Broken	7.20	7.42	7.57	7.73	7.78	[4] 7.96	7.94	7.89
Egg	7.28	7.80	8.31	8.29	8.27	[4] 8.62	8.31	8.31
Stove	7.56	7.91	8.40	8.50	8.63	[4] 9.01	8.78	8.68
Chestnut	7.50	[3] 7.96	[3] 8.35	[3] 8.34	[3] 8.31	[3,4] 8.59	8.31	8.27
Pea	5.64	5.80	5.96	5.45	5.14	[4] 5.89	5.83	5.01
Total domestic	7.30	7.70	8.09	8.08	8.21	[4] 8.58	8.31	8.12
Buckwheat No. 1	3.40	3.58	3.48	3.11	2.55	[4] 2.66	[5] 2.61	[5] 2.82
Buckwheat No. 2 (rice) [6]	2.25	2.35	2.18	1.91	1.85	1.81	1.82	1.88
Buckwheat No. 3 (barley)	1.48	1.57	1.40	1.29	1.38	1.34	1.37	1.40
Total steam [2]	2.77	2.83	2.67	2.40	2.15	[4] 2.13	2.13	2.24
Total, all sizes	6.34	6.62	6.92	6.85	6.83	[4] 7.10	6.83	6.68
Total, including Sullivan County:								
Lump	7.01	7.70	8.35	5.18	8.85	[4] 9.32	(1)	--------
Broken	7.37	7.65	7.85	7.93	7.94	[4] 8.19	[1] 8.17	8.10
Egg	7.42	7.91	8.49	8.45	8.39	[4] 8.75	8.35	8.33
Stove	7.67	8.03	8.56	8.74	8.79	[4] 9.14	8.86	8.72
Chestnut	7.66	[3] 8.07	[3] 8.53	[3] 8.59	[3] 8.48	[3,4] 8.75	8.38	8.31
Pea	5.74	5.92	6.18	5.60	5.27	[4] 5.98	5.90	5.00
Total domestic	7.39	7.77	8.23	8.25	8.30	[4] 8.66	8.33	8.09
Buckwheat No. 1	3.43	3.56	3.48	2.94	2.49	[4] 2.52	[5] 2.56	[5] 2.75
Buckwheat No. 2 (rice) [6]	2.27	2.37	2.23	1.93	1.84	1.78	1.78	1.85
Buckwheat No. 3 (barley)	1.45	1.57	1.41	1.30	1.32	1.32	1.32	1.38
Total steam [2]	2.75	2.77	2.64	2.25	2.00	[4] 1.94	1.98	2.12
Total, all sizes	6.27	6.48	6.77	6.70	6.59	[4] 6.84	6.50	6.38

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[1] An insignificant quantity of lump is included with the broken coal.

[2] Includes all other steam sizes.

[3] Includes range coal.

[4] The figures are based on complete reports of tonnage and value from all important producers except one company in the Wyoming region which reported the tonnage of each size but not the value. To round out the totals, estimates of the value of this company's shipments were made. In 1926 a change in the method of estimate was introduced which yields a more accurate result. The figures for 1926, 1927, and 1928, as shown above (except for buckwheat No. 1), are therefore strictly comparable with each other but not with those for earlier years. The effect of the change in method is shown by the following statement of the averages for 1926 if calculated according to the method of estimate used in 1920–1925:

	Broken	Egg	Stove	Chestnut	Pea	Total domestic	Buckwheat No. 1	Total steam	All sizes
Wyoming	$7.92	$8.49	$8.92	$8.48	$5.87	$8.48	$2.42	$2.02	$7.00
All regions	8.15	8.66	9.09	8.69	5.98	8.60	2.39	1.88	6.78

The change in method of estimate is fully discussed in Coal in 1926, p. 576.

[5] The average for buckwheat No. 1 in 1927 and 1928 was computed according to the method used in 1920–1925.

[6] Includes bird's-eye coal.

AVERAGE VALUES OF SHIPMENTS, LOCAL SALES, AND COLLIERY FUEL

Table 21A shows by regions the average value per ton for all shipments, all local sales, and colliery fuel in each year from 1919 to 1928. The receipts from local sales average distinctly lower than those from shipments, a difference mainly accounted for by the large proportion of pea coal in the local sales. (See Table 19A.) In 1928 the shipments brought $6.25 and the local sales $4.98, or $1.27 less. The figures in the following table include the sales of dredge and washery coal as well as breaker coal.

TABLE 21A.—*Average value per gross ton of anthracite shipped, local sales, colliery fuel, and total production, by regions, 1919–1928*[1]

Year and region	Shipments	Local sales	Colliery fuel	Total
1919				
Lehigh	$4.86	$3.37	$1.80	$4.51
Schuylkill	4.94	3.43	.85	4.31
Wyoming	5.21	4.55	1.55	4.85
Sullivan County	4.63	4.70	2.29	4.36
	5.08	3.98	1.32	4.64
1920				
Lehigh	5.88	3.29	1.94	5.34
Schuylkill	5.70	4.14	.90	4.99
Wyoming	6.15	5.17	1.80	5.71
Sullivan County	5.60	5.71	2.33	5.27
	5.97	4.44	1.47	5.43
1921				
Lehigh	6.13	3.50	1.59	5.54
Schuylkill	6.03	4.19	.65	5.22
Wyoming	6.29	5.64	1.27	5.82
Sullivan County	6.21	6.20	2.30	5.53
	6.20	4.75	1.08	5.60
1922				
Lehigh	6.05	3.97	2.34	5.56
Schuylkill	5.78	4.44	.78	4.98
Wyoming	6.52	5.78	1.69	6.02
Sullivan County	5.22	6.18	2.00	4.84
	6.21	5.07	1.38	5.61
1923				
Lehigh	6.36	3.80	1.77	5.84
Schuylkill	6.31	3.87	.72	5.63
Wyoming	6.81	5.92	1.43	6.40
Sullivan County	6.81	6.56	2.60	6.73
	6.60	4.80	1.21	6.08
1924				
Lehigh	$6.54	$4.53	$1.68	$6.03
Schuylkill	6.33	4.05	.45	5.57
Wyoming	6.81	6.14	.97	6.36
Sullivan County	5.11	7.15	1.98	5.10
	6.63	5.15	.87	6.08
1925				
Lehigh	6.24	4.49	1.57	5.79
Schuylkill	5.98	4.06	.42	5.22
Wyoming	6.78	6.01	1.12	6.37
Sullivan County	5.49	6.93	1.85	5.05
	6.47	5.06	.88	5.94
1926				
Lehigh	6.29	4.85	2.34	6.01
Schuylkill	6.41	3.98	.93	5.77
Wyoming	[2]7.05	5.77	1.46	[2]6.63
Sullivan County	5.90	7.06	1.08	5.23
	[2]6.76	4.95	1.35	[2]6.29
1927				
Lehigh	6.04	4.49	2.40	5.73
Schuylkill	5.77	4.14	.42	5.13
Wyoming	6.79	5.72	1.30	6.36
Sullivan County	4.67	7.03	1.50	4.21
	6.37	4.97	1.07	5.89
1928				
Lehigh	6.04	4.83	2.37	5.74
Schuylkill	5.64	4.07	1.76	5.19
Wyoming	6.63	5.59	1.44	6.26
Sullivan County	5.08	6.86	1.75	4.59
	6.25	4.98	1.68	5.85

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[1] Value given for shipments is value at which coal left possession of producing company f. o. b. mines and does not include margins of separately incorporated selling companies.

[2] See Table 20A, footnote 4. Had the same method of computation been used as in earlier years the average value for shipments for the Wyoming region would have been $6.94 and for all regions $6.70, and the average value of the total production for the Wyoming region would have been $6.54 and for all regions $6.24.

NUMBER OF OPERATIONS

The economic trend within the industry toward adjustment of its productive capacity to the requirements of the changing market is indicated by the decline in the number of breakers in operation. Two hundred and twenty-six breakers produced anthracite in 1928, 9 less than in 1927 and 31 less than in 1923. The number of breakers, however, is generally less than the total number of mines or workings, as a single breaker often handles the coal from several mines.

While the product of washeries declined 11.6 per cent in comparison with 1927, there was a small increase in the number of active washeries. Four more dredges were also in operation, bringing the number of dredges to 49, the same as in 1924 and 1926.

TABLE 22A.—*Number of anthracite breakers, washeries, and dredges active, 1919–1928*

	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928
Lehigh:										
Breakers	34	36	33	32	33	33	32	33	32	31
Washeries	12	10	11	11	12	6	6	1	------	------
Dredges	3	3	1	4	3	3	2	1	2	2
	49	49	45	47	48	42	40	35	34	33
Schuylkill:										
Breakers	80	78	79	78	78	78	76	77	75	74
Washeries	24	19	17	24	26	13	7	11	9	9
Dredges	74	56	59	56	56	45	49	46	43	47
	178	153	155	158	160	136	132	134	127	130
Wyoming:										
Breakers	142	135	130	131	144	133	128	127	126	119
Washeries	42	33	27	34	44	22	22	26	13	15
Dredges	3	1	2	2	1	1	2	2	------	------
	187	169	159	167	189	156	152	155	139	134
Sullivan County: Breakers	3	3	3	2	2	3	2	2	2	2
Total breakers	259	252	245	243	257	247	238	239	235	226
Total washeries	78	62	55	69	82	41	35	38	22	24
Total dredges	80	60	62	62	60	49	53	49	45	49
Grand total	417	374	362	374	399	337	326	326	302	299

LABOR STATISTICS

The total number of men and boys at work in the mines, dredges, and preparation plants, not including supervisory forces and office workers, was 160,681. This was 4,578 less than in 1927 but very close to the number of workers employed in 1924 and 1925. In comparison with 1927 there was a reduction of 3,301 in underground employees and of 1,277 in surface workers.

The average number of days worked by breakers was 217 in comparison with 225 in 1927 and with 245 in 1926. Dredges, which averaged 191 days, and washeries, which averaged 197 days, both showed a loss of working time in comparison with 1927. (Table 23A.)

TABLE 23A.—*Men employed and days worked in the anthracite field, by regions, 1927 and 1928*

Region	Average number employed						Average number of days worked
	Surface	Underground				Total	
		Miners and their laborers[1]	Haulage and track	Other	Total		
1927							
Lehigh:							
Breakers	5,864	8,724	1,543	4,113	14,380	20,244	232
Dredges	9					9	156
	5,873	8,724	1,543	4,113	14,380	20,253	232
Schuylkill:							
Breakers	13,541	23,118	4,130	8,797	36,045	49,586	219
Washeries	402					402	208
Dredges	325					325	209
	14,268	23,118	4,130	8,797	36,045	50,313	218
Wyoming:							
Breakers	17,629	50,428	12,448	13,423	76,299	93,928	228
Washeries	141					141	218
	17,770	50,428	12,448	13,423	76,299	94,069	228
Sullivan County: Breakers	151	313	65	95	473	624	107
Total breakers	[2]37,185	82,583	18,186	26,428	127,197	164,382	225
Total washeries	543					543	211
Total dredges	334					334	207
Grand total	38,062	82,583	18,186	26,428	127,197	165,259	225
1928							
Lehigh:							
Breakers	5,596	8,385	1,526	4,128	14,039	19,635	211
Dredges	9					9	185
	5,605	8,385	1,526	4,128	14,039	19,644	211
Schuylkill:							
Breakers	12,763	22,580	3,919	7,999	34,498	47,261	209
Washeries	466					466	174
Dredges	300					300	191
	13,529	22,580	3,919	7,999	34,498	48,027	209
Wyoming:							
Breakers	17,272	50,401	10,668	13,873	74,942	92,214	222
Washeries	244					244	241
	17,516	50,401	10,668	13,873	74,942	92,458	222
Sullivan county: Breakers	135	261	70	86	417	552	109
Total breakers	[2]35,766	81,627	16,183	26,086	123,896	159,662	217
Total washeries	710					710	197
Total dredges	309					309	191
Grand total	36,785	81,627	16,183	26,086	123,896	160,681	217

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[1] Operators were requested to give number of "all miners (contract, consideration, and company) and their laborers."

[2] Includes a comparatively small number of washery employees who could not be separated from breaker employees.

TABLE 24A.—*Strikes, suspensions, and lockouts in the anthracite region, 1923–1928*

	Lehigh	Schuylkill	Wyoming	Sullivan County	Total
1923					
Total number employed	20,639	49,350	86,978	776	157,743
Men on strike	18,593	43,524	72,772	696	135,585
Man days lost account strike	354,830	805,640	1,456,364	12,584	2,629,418
Average days lost:					
Per man employed	17	16	17	16	17
Per man on strike	19	19	20	18	19
1924					
Total number employed	20,331	50,456	88,504	718	160,009
Men on strike	10,145	12,333	48,795	------------	71,273
Man days lost account strike	151,243	86,429	905,958	------------	1,143,630
Average days lost:					
Per man employed	7	2	10	------------	7
Per man on strike	15	7	19	------------	16
1925					
Total number employed	19,579	50,745	89,399	589	160,312
Men on strike	18,751	45,715	82,876	586	147,928
Man days lost account strike	1,863,605	4,675,143	8,661,264	69,494	15,269,506
Average days lost:					
Per man employed	95	92	97	118	95
Per man on strike	99	102	105	119	103
1926					
Total number employed	20,133	50,138	94,469	646	165,386
Men on strike	17,074	44,309	83,381	612	145,376
Man days lost account strike	723,550	1,825,482	3,415,913	25,532	5,990,477
Average days lost:					
Per man employed	36	36	36	40	36
Per man on strike	42	41	41	42	41
1927					
Total number employed	20,253	50,313	94,069	624	165,259
Men on strike	5,073	2,991	12,414	------------	20,478
Man days lost account strike	20,112	5,771	133,359	------------	159,242
Average days lost:					
Per man employed	1	(1)	1	------------	1
Per man on strike	4	2	11	------------	8
1928					
Total number employed	19,644	48,027	92,458	552	160,681
Men on strike	7,872	1,158	27,098	------------	36,128
Man days lost account strike	33,720	3,299	363,663	------------	400,682
Average days lost:					
Per man employed	2	(1)	4	------------	2
Per man on strike	4	3	13	------------	11

[1] Less than one-half day.

METHODS OF MINING

Out of 64,417,666 tons of fresh-mined coal produced in 1928 only 1,151,615 tons, or 1.8 per cent, was cut by machine. (Table 25A.) This is a small increase over 1927, but natural conditions in the anthracite mines do not favor the widespread use of cutting machines. The output mechanically cut in 1928 was obtained with 193 mining machines, of which 176 were at work in the Wyoming region and 15 in Sullivan County. The use of cutting machines is confined almost entirely to these two regions, where the beds are less steeply inclined.

As shown in Table 26A, strip mining is carried on in all three major regions. In 1928, 108 shovels produced 2,163,325 tons, an increase of 240,864 tons over 1927.

TABLE 25A.—*Anthracite mined by machines, 1926–1928*

Region	1926		1927		1928	
	Number of machines	Gross tons	Number of machines	Gross tons	Number of machines	Gross tons
Lehigh			1	(1)	1	(1)
Schuylkill	2	4,032	1	(1)	1	(1)
Wyoming	74	732,897	121	[1] 983,829	176	[1] 1,093,055
Sullivan County	14	94,254	15	62,500	15	58,560
	90	831,183	138	1,046,329	193	1,151,615

[1] Lehigh and Schuylkill included with Wyoming.

TABLE 26A.—*Anthracite recovered from steam-shovel strip pits, 1926–1928*

Region	1926		1927		1928	
	Number of shovels	Gross tons	Number of shovels	Gross tons	Number of shovels	Gross tons
Lehigh	43	1,072,392	41	967,210	40	1,073,043
Schuylkill	40	818,443	45	745,696	45	881,191
Wyoming	16	253,233	26	209,555	23	209,091
	99	2,144,068	112	1,922,461	108	2,163,325

DREDGE OPERATIONS

In 1928, 49 dredges reported to the Bureau of Mines a production of 842,322 tons, valued at $821,530. (Table 27A.)

The "river coal" consists chiefly of sizes equivalent to buckwheat No. 3 and boiler. It is sold mainly for steam-raising purposes, and prices obtained for dredge coal have averaged about $1 per gross ton in the last five years. The average of 98 cents per gross ton in 1928, although lower than the averages for 1925 and 1926, represented a gain of 4 cents over 1924 and of 6 cents over 1927. The average receipts per ton on all coal sold, including local sales as well as shipments, have been as follows:

1921	$1.17	1925	$1.02
1922	1.23	1926	1.01
1923	.95	1927	.92
1924	.94	1928	.98

In the winter dredging is handicapped by cold weather. The seasonal nature of the industry is shown by Table 28A, which gives the number of employees in each month.

TABLE 27A.—*Anthracite produced by dredges, by rivers, 1927 and 1928*

River (including tributaries)	Number of dredges	Gross tons	Value	River (including tributaries)	Number of dredges	Gross tons	Value
1927				1928			
Lehigh	2	76,051	$89,592	Lehigh	2	79,736	$103,445
Schuylkill	9	114,022	106,758	Schuylkill	11	140,579	146,041
Susquehanna	34	677,621	598,457	Susquehanna	36	622,007	572,044
	45	867,694	794,807		49	842,322	821,530

TABLE 28A.—*Number of employees on pay rolls of anthracite-dredge operations on the 1st day of each month, 1926–1928*

Month	1926	1927	1928	Month	1926	1927	1928
January	182	107	110	July	433	363	449
February	191	132	172	August	419	362	385
March	248	174	269	September	399	327	340
April	344	285	381	October	389	319	263
May	412	334	438	November	336	266	211
June	441	354	468	December	250	160	122

MICA[1]

By B. H. Stoddard[2]

PRODUCTION

The total quantity of uncut mica sold by producers in the United States in 1928 was 8,601 short tons, valued at $363,378. Of this quantity 1,681,777 pounds (841 tons), valued at $230,956, was sheet mica, consisting of 1,468,482 pounds of punch or circle mica, valued at $90,931, or an average value of 6 cents a pound, and 213,295 pounds of mica larger than punch, valued at $140,025, or an average value of 66 cents a pound. These figures indicate an increase in punch or circle mica of 12 per cent in quantity and a decrease of 4 per cent in value, and increases in mica larger than punch of 8 per cent in quantity and 19 per cent in value, as compared with 1927. The total sales of sheet mica, including punch or circle and mica larger than punch, increased 11 per cent in quantity and 9 per cent in value, as compared with 1927. Sales of scrap mica increased 24 per cent in quantity and 20 per cent in value.

The chief producing States in 1928 were, as usual, New Hampshire and North Carolina. Sales of punch mica increased 8 per cent in quantity and decreased 25 per cent in value in New Hampshire and increased 21 per cent in quantity and 22 per cent in value in North Carolina, as compared with 1927. Sales of uncut mica larger than punch increased 0.8 per cent in quantity and 0.06 per cent in value in New Hampshire and 0.3 per cent in quantity and 11 per cent in value in North Carolina.

The average value of scrap mica in 1928 was about $17 a short ton, as compared with about $17.50 in 1927.

Domestic mica sold by producers in the United States, 1920–1928

Year	Sheet mica						Scrap mica		Total	
	Uncut punch mica		Uncut mica larger than punch		Total uncut sheet mica					
	Pounds	Value	Pounds	Value	Pounds	Value	Short tons	Value	Short tons	Value
1920	1,153,540	$115,770	529,940	$431,202	1,683,480	$546,972	5,723	$167,017	6,565	$713,989
1921	675,787	67,516	66,058	50,997	741,845	118,513	2,577	56,849	2,948	175,362
1922	911,433	71,127	166,535	123,174	1,077,968	194,301	[a]6,641	114,045	[a]7,180	308,346
1923	1,793,749	134,955	269,430	176,225	2,063,179	311,180	[a]8,054	129,695	[a]9,086	440,875
1924	1,305,219	113,285	155,678	98,750	1,460,897	212,035	4,709	87,242	5,439	299,277
1925	790,183	75,528	1,003,682	246,434	1,793,865	321,962	9,695	173,537	10,592	495,499
1926	1,842,970	228,053	329,189	172,131	2,172,159	400,184	7,043	136,643	8,129	536,827
1927	1,314,742	95,011	197,750	117,471	1,512,492	212,482	6,280	110,139	7,036	322,621
1928	1,468,482	90,931	213,295	140,025	1,681,777	230,956	7,760	132,422	8,601	363,378

[a] Includes mica derived from mica schist.

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[1] Work on manuscript completed January, 1930. Discussion of the occurrence, mining, preparation, classification, and uses of mica may be found in the chapters of this series in Mineral Resources of the United States for 1925, 1926, and 1927, part 2.

[2] Figures on imports and exports compiled by J. A. Dorsey, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.

Mica sold by producers in chief producing States, 1924–1928

State and year	Sheet mica						Scrap mica		Total	
	Uncut punch mica		Uncut mica larger than punch		Total uncut sheet mica					
	Pounds	Value	Pounds	Value	Pounds	Value	Short tons	Value	Short tons	Value
New Hampshire:										
1924	740,593	$83,099	3,540	$5,638	744,133	$88,737	492	$9,498	864	$98,235
1925	267,607	40,096	853,250	158,762	1,120,857	198,858	1,953	47,525	2,513	246,383
1926	1,220,053	188,850	151,837	47,040	1,371,890	235,890	1,738	38,213	2,424	274,103
1927	674,219	60,744	46,000	18,105	720,219	78,849	1,284	22,909	1,644	101,758
1928	727,775	45,354	46,368	18,116	774,143	63,470	1,291	25,232	1,678	88,702
North Carolina:										
1924	460,152	24,076	137,233	84,580	597,385	108,656	3,212	59,620	3,511	168,276
1925	467,418	30,279	125,060	75,097	592,478	105,376	5,095	74,818	5,391	180,194
1926	541,990	33,847	158,323	116,515	700,313	150,362	2,880	54,048	3,230	204,410
1927	528,978	27,347	136,382	87,167	665,360	114,514	2,995	50,505	3,328	165,019
1928	640,585	33,326	136,810	96,380	777,395	129,706	4,419	69,638	4,808	199,344

REVIEW BY STATES

Alabama.—The output of mica in Alabama in 1928 was reported by dealers who purchased from small operators.

Colorado.—A production of punch mica in Colorado was reported by W. W. Hamilton, Golden, who did not give information concerning the location of the producing property. Sales of scrap mica were made by E. W. Lehman, who operated the High Line mine, near Jamestown, Boulder County. A small output of vermiculite from the Inspiration mine, about 5 miles southeast of Hecla, Chaffee County, was reported by D. E. C. Austin of Turret.

Connecticut.—The Eureka Flint & Spar Co., Trenton, N. J., operated the Strickland mine, 2½ miles northeast of Portland, Middlesex County, under lease and sold the product as mine run.

Georgia.—The only output of mica reported to the Bureau of Mines from Georgia in 1928 was from W. R. Rowland, Yatesville; it was obtained from the Sullivan mine, near Thomaston, Upson County. Sales of chlorite schist were reported by Thompson, Weinman & Co. (Inc.), Canton, from its property at Canton.

Idaho.—No sales of mica were reported from Idaho in 1928. A. H. Clark and R. G. Bennett, of Huntington, Oreg., have become partners in the development of mica property in Idaho on the middle fork of Weiser River, near Council, Adams County. Workings have uncovered "three very fine ledges or dikes," according to their report, and a cross-cut tunnel has already been driven. Mr. Bennett has also leased for three years the Mica Queen and the Gill Rinehart group of claims.

Maine.—The only mica output reported to the Bureau of Mines from Maine in 1928 was from Harold C. Perham, who worked the Hibbs mine, 1½ miles north of Hebron.

Montana.—No sales of mica were reported from Montana in 1928. The Idaho Mica Mining Co., Dubois, Idaho, reported the production of several thousand pounds of punch and mica larger than punch from Madison County (no more definite location given). The company reports that the working consists of several cuts and one shaft and that the mica is practically all clear. Samples only were shipped in 1928. In addition to the mica mined in Montana in 1928, more than 1,000 tons of vermiculite was mined and sold—by the Vermiculite & Asbestos Co., Libby, from its mine near Libby, Lincoln County, and the Zonolite Co., Libby, from the Zonolite mine, near Libby.

New Hampshire.—New Hampshire produced 46 per cent of the total quantity of domestic sheet mica sold by producers in the United States in 1928, as compared with 48 per cent of the total in 1927. The General Electric Co. operated its Alexandria mine in Grafton County, and the production greatly exceeded that of 1927. The Golding-Keene Co., Keene, operated the Golding-Keene mine at Alstead, Cheshire County, and sold the output, as usual, in mine-run form to the Keene Mica Products Co., Keene, who manufacture mica insulation. The Maine Feldspar Co., Brunswick, Me., produced and sold a small quantity of scrap mica which was obtained from the Cardigan quarry, in Grafton County, near Grafton. The New England Mica Co., Waltham, Mass., reported sales of washer and scrap mica from the Ruby mine at Grafton to an eastern consumer, and also reported that the mine had been leased to an eastern concern. The New England Minerals Co. (Inc.) did not report the names or locations of the mines it operated in 1928; its output was more than three times that in 1927. The sheet mica is all sold in manufactured form as washers, disks, special shapes, and square cuts. The scrap mica produced by this company is dry ground and sold in powdered form. The New Hampshire Mica & Mining Co. again operated the French mine at Alstead, Cheshire County, and produced sheet mica in several sizes, from punch or washer to 6 by 8 inches and larger, and scrap mica.

New Mexico.—E. D. Grube reported that sheet and scrap mica produced at the mines of the New Mexico Mica Corporation, in Rio Arriba County, near Petaca, were sold to mid-west and western consumers. Philip S. Hoyt reported that sales of sheet mica (all sizes) and scrap were made from the Las Tablas mines near Las Tablas, Rio Arriba County. The company name has been changed from the Hoyt Mineral Corporation to the Fremont Mining & Manufacturing Co., and the address is Las Tablas. The L. M., Cribbenville, and Alamos mines in Rio Arriba County, near Petaca, yielded several hundred pounds of sheet mica larger than punch and scrap mica. The mines were operated by C. L. Johnson, La Madera, and the entire output was sold to a Chicago consumer. Assessment work was carried on at the Ortez No. 1, El Paso, and La Jasita mines of the Eureka Mica Mining Co., Vaughn, and at the L. M. No. 3 mine, operated by George M. Neel, Santa Fe. H. A. Stark, of the Mica Industries (Ltd.), Chicago, reported that plans were being formulated for extensive work in 1929 to include the operation of Wyoming properties; the company controls the Silver Plate mine in Rio Arriba

County, near Petaca. The General Mica Co., Joseph A. Stanko, Pueblo, Colo., reported that the General Mica Mines in Taos County, near Ojo Caliente, produced several hundred tons of scrap mica which was sold to Illinois and Virginia consumers; the property was formerly operated by H. K. Thurber. Assessment work was continued at the Augusta mine, in Rio Arriba County, near Petaca, but no sales were made.

North Carolina.—Sales of sheet mica by producers in North Carolina in 1928 were 46 per cent of the total quantity of sheet mica sold by producers in the United States, as compared with 44 per cent of the total in 1927. Sales increased 17 per cent in quantity and 13 per cent in value, as compared with 1927. Sales of scrap mica in 1928 increased 48 per cent in quantity and 38 per cent in value, as compared with 1927, and were 57 per cent of the total scrap mica sold by producers in the United States. Average values in 1928 were 5 cents a pound for punch mica, 70 cents a pound for mica larger than punch, and $16 a ton for scrap mica.

In addition to the mica sold in North Carolina, muscovite schist was ground by the Victor Mica Co., Spruce Pine, and sold to the roofing trade. Biotite schist was ground and sold by the Biotite Mica Co., Spruce Pine.

South Dakota.—Sales of scrap mica in South Dakota in 1928 were, as usual, made by the Keystone Feldspar & Chemical Co., who operated the Hugo and Peerless mines near Keystone. The output was sold to a consumer in Chicago. The mines are leased from the Reinbold Metallurgical Co., Omaha, Nebr.

Virginia.—The General Minerals Corporation (formerly the Pegmatite Minerals Co.), Chula, reported sales of sheet and scrap mica from the Jones, Ligon, Rutherford, and H. Taylor mines in Amelia County, near Chula.

SCRAP AND GROUND MICA

Mica which is not suitable for use as sheet mica is classed as "scrap" mica. It is ground to a powder and used in the decorative trade in the manufacture of wall paper, fancy paint, ornamental tile, and concrete facing, and for other purposes; as a lubricant both dry, as for auto tires, and mixed with oil and greases; for axle grease; for annealing steel; as a dusting agent for rolled roofing; for the manufacture of Christmas-tree snow; as an insulator for pipe and boiler covering; fireproof paint; and in various other ways.

The following figures distribute the 1928 sales of ground mica by methods of grinding and by consuming industries in the United States, in so far as reported by producers. The figures do not represent the total production of ground mica in the United States, for in addition to the part of the production which is shipped to foreign consumers there is also unaccounted for a part of the scrap-mica output which has not been traced to points of consumption where it may be ground by the consumers.

Ground mica sold in the United States, 1924–1928, by methods of grinding

Year	Dry ground		Wet ground		Total	
	Pounds	Value	Pounds	Value	Pounds	Value
1924	5,184,000	$101,700	5,735,000	$331,410	10,919,000	$433,110
1925	5,043,020	101,680	4,803,930	279,940	9,846,950	381,620
1926	4,750,790	98,290	4,980,400	206,370	9,731,190	304,660
1927	5,187,063	90,968	6,398,320	332,511	11,585,383	423,479
1928	5,743,052	95,151	6,633,965	358,458	12,377,017	453,609

Ground mica sold to various industries in the United States in 1928

Industry	Quantity		Value
	Pounds	Percentage	
Rubber	3,865,630	31	$172,180
Wall paper	3,227,350	26	182,247
Roofing	2,587,300	21	32,283
Miscellaneous[1]	2,696,737	22	66,899
	12,377,017	100	453,609

[1] Figures cover mica used for molded electric insulation, surfacing on asphalt shingles, filler for fancy paints, ornamental tile, Christmas-tree snow, manufacture of axle greases and oil, annealing, concrete facing, and calico printing.

CONSUMPTION OF MICA SPLITTINGS

The consumption of mica splittings in the United States in 1928, as reported by consumers, was as follows: Indian splittings, 2,508,035 pounds, valued at $977,530; Canadian splittings, 381,131 pounds, valued at $145,859; and Madagascan splittings, 253,048 pounds, valued at $170,555. Some domestic and South American splittings were used by consumers, but the Bureau of Mines is not at liberty to publish the figures.

PRICES

In 1928 the range of prices per pound for rough-trimmed uncut sheet mica, as reported to the Bureau of Mines by producers and others engaged in the industry, was as follows:

Range of prices per pound for rough-trimmed uncut sheet mica in 1928

Size	Clear	Stained	Size	Clear	Stained
Punch	$0.05–$0.15	$0.04–$0.05	3 by 4 inches	$1.60–$2.20	$0.75–$1.50
1½ by 2 inches	.10– .50	.08– .15	3 by 5 inches	1.50– 2.64	1.20– 1.65
2 by 2 inches	.40– .75	.15– .30	4 by 6 inches	2.00– 2.75	1.25– 2.00
2 by 3 inches	.35– 1.25	.20– .50	6 by 8 inches	2.75– 4.00	1.50– 2.00
3 by 3 inches	.75– 1.75	.60– 1.00	8 by 10 inches	4.00– 6.00	1.50– 2.50

Prices of scrap mica a short ton ranged from $10 to $30 at the mines.

IMPORTS AND EXPORTS

Mica imported for consumption in 1928 included unmanufactured, ground, cut (dimension sheets), splittings, built-up mica boards, cups, tubes, and mica plates, washers, and other manufactures. The imports of uncut sheet mica in 1928, exclusive of the Madras square-shaped uncut sheets, were 541,635 pounds, valued at $294,194, a decrease of 30 per cent in quantity and 26 per cent in value as compared with 1927. Imports of ground mica in 1928 were only 150 pounds, valued at $53. Imports of cut mica (dimension sheets) decreased 23 per cent in quantity but increased 25 per cent in value. Imports of mica splittings, which constituted 85 per cent of the total quantity of mica imported in 1928, increased 35 per cent in quantity but decreased 9 per cent in value. Imports of built-up mica boards, etc., decreased 38 per cent in quantity and 51 per cent in value. Imports of washers increased 90 per cent in quantity and 141 per cent in value.

Mica imported for consumption in the United States, 1923–1928

Kind	1923		1924		1925	
	Pounds	Value	Pounds	Value	Pounds	Value
Unmanufactured [1]	1,044,366	$532,375	671,793	$419,154	604,550	$526,292
Ground	1,867,385	28,324	1,342,107	22,034	950,614	13,120
Cut mica (dimension sheets)	60,135	49,268	74,534	69,018	41,284	63,466
Splittings	4,301,727	1,730,532	3,619,229	1,681,774	3,239,554	1,113,202
Built-up mica boards, cups, tubes, and mica plates	30,032	37,382	18,205	41,455	14,639	16,785
Washers	20,164	6,776	18,517	5,325	222	50
Other manufactures	7,044	20,191	56,766	88,146	50,445	65,912
	7,330,853	2,404,848	5,801,151	2,326,906	4,901,308	1,798,827

Kind	1926		1927		1928	
	Pounds	Value	Pounds	Value	Pounds	Value
Unmanufactured [1]	818,381	$562,300	776,307	$399,302	541,635	$294,194
Ground	140,732	2,048			150	53
Cut mica (dimension sheets)	46,662	44,621	64,075	75,469	49,555	93,964
Splittings	5,229,858	1,750,434	2,588,253	1,123,808	3,496,353	1,025,790
Built-up mica boards, cups, tubes, and mica plates	15,147	15,410	8,097	9,211	4,986	4,539
Washers	4,620	1,723	1,732	536	3,296	1,291
Other manufactures	62,696	74,298	21,183	21,983	9,000	6,664
	6,318,096	2,450,834	3,459,647	1,630,309	4,104,975	1,426,495

[1] Essentially uncut trimmed sheets.

The following table, showing mica imported (general imports) into the United States by kinds and by countries, indicates that imports from India formed 69 per cent of the total. Mica from India is uncut sheet and splittings, but the proportions are not known. Although Madras square-trimmed mica is termed "cut mica" in import schedules, in reality it is uncut trimmed mica. Mica from Canada is almost entirely phlogopite, and that from India is muscovite. Seventyfour per cent of the mica imported into the United States in 1928 came from these two countries. It is interesting to observe that imports of mica from Brazil and Madagascar increased greatly over those recorded for 1927, whereas imports from Canada decreased greatly or from 596,693 pounds in 1927 to 190,349 pounds in 1928. Imports from Guatemala and British India also increased, but not so greatly as those from Brazil and Madagascar.

Mica imported into the United States in 1928, by kinds and by countries

]General Imports[

Country	Crude or unmanufactured				Cut mica, dimension sheets (duty 30 per cent)		Mica splittings (duty 30 per cent)		Ground mica	
	Valued at not above 15 cents per pound (duty 4 cents per pound)		Valued at above 15 cents per pound (duty 25 per cent)							
	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value
Africa:										
Madagascar			14,105	$5,976			123,816	$43,009		
Union of South Africa	2,038	$71	2,668	1,235						
Argentina	1,245	178	56,416	26,690						
Brazil	5,613	568	29,171	15,280						
Canada	38,442	3,096	42,268	12,414	25	$65	109,375	59,477	150	$53
Costa Rica			1,414	754						
France	1,785	271	46,293	17,542	12,071	42,589	204,934	74,695		
Germany			3,168	1,606	7,735	11,077	1,692	1,795		
Guatemala			15,378	7,376	1,413	896	200	139		
India, British	4,920	631	153,995	102,778	7,807	7,208	2,381,186	603,955		
Japan							12,406	3,702		
Sweden			474	423						
United Kingdom			83,123	60,385	12,518	19,539	300,148	55,060		
	54,043	4,815	448,473	252,459	41,569	81,374	3,133,757	841,832	150	53

Country	Built-up mica products, boards, cups, tubes, and mica plates (duty 40 per cent)		Washers (duty 30 per cent)		Other manufactures, not specially provided for (duty 40 per cent)		Total	
	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value
Africa:								
Madagascar							137,921	$48,985
Union of South Africa							4,706	1,306
Argentina							57,661	26,868
Brazil					1,062	$585	35,846	16,433
Canada			27	$25	62	44	190,349	75,174
Costa Rica							1,414	754
France					1,515	946	266,598	136,043
Germany	3,918	$2,218			292	394	16,805	17,090
Guatemala			1,758	531			18,749	8,942
India, British			1,500	790	1,800	1,101	2,551,208	716,463
Italy					238	131	238	131
Japan							12,406	3,702
Sweden							474	423
United Kingdom					286	451	396,075	135,435
	3,918	2,218	3,285	1,346	5,255	3,652	3,690,450	1,187,749

Mica and manufactures of mica exported in 1928 amounted to 3,661,587 pounds, valued at $229,391, compared with 2,867,798 pounds, valued at $207,263, in 1927. As the classes of mica are not shown in export schedules, it is impossible to state what kinds of mica are exported.

WORLD PRODUCTION

World production of mica, 1924–1928, in metric tons

[Compiled under supervision of L. M. Jones, of the Bureau of Mines]

Country	1924	1925	1926	1927	1928
North America:					
Canada (sales)	3,711	3,647	2,309	2,484	3,320
Guatemala	(1)	10	12	7	[2] 13
United States (sales)	4,934	9,609	7,374	6,383	7,803
South America:					
Argentina	[2] 120	[3] 152	[3] 99	[3] 106	[3] 120
Brazil[2]	79	65	52	39	44
Europe:					
Norway[2]	25	23	42	8	85
Russia[4]	(1)	18	65	15	(1)
Sweden	4	95	53	10	12
Asia:					
Ceylon[2]	--------	1	--------	--------	--------
Chosen	23	20	16	35	29
India, British[5]	3,561	5,065	4,569	3,937	4,850
Japan	592	1,082	(1)	(1)	(1)
Russia[4]	(1)	175	421	1,505	(1)
Africa:					
Ethiopia	--------	--------	--------	2	--------
Madagascar[6]	286	288	330	505	861
Rhodesia—					
Northern	--------	--------	4	8	4
Southern	136	132	166	186	186
Tanganyika Territory	56	69	53	43	33
Union of South Africa (Transvaal) (sales)	735	1,462	872	1,454	3,419
Oceania:					
Australia—					
Central Australia[7]	3	3	3	2	23
North Australia[7]				--------	--------
Queensland	--------	1	--------	1	--------
South Australia	--------	--------	--------	--------	2
Western Australia[2]	--------	--------	4	4	--------

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[1] Data not available.

[2] Exports.

[3] Railroad shipments.

[4] Year ended Sept. 30.

[5] Exports. The figures for output are incomplete, and a more accurate idea of the size of the industry is to be obtained from the export figures. (Rec. Geol. Surv. of India, vol. 59, pt. 3, p. 273. Calcutta, 1926.) Output is reported as follows: 1924, 2,078 tons; 1925, 2,336 tons; 1926, 2,130 tons; 1927, 2,165 tons; 1928, 2,292 tons.

[6] Exports reported as follows: 1924, 286 tons; 1925, 267 tons; 1926, 296 tons; 1927, 544 tons; 1928, 635 tons.

[7] Northern Territory prior to division in 1927 into Central Australia and North Australia.

PETROLEUM[1]

By G. R. Hopkins and A. B. Coons[2]

SUMMARY

The total output of crude petroleum during 1928 established the new high record of 901,474,000 barrels, compared with 901,129,000 barrels in 1927. Texas, with an output of 257,320,000 barrels, was for the first time the leading producing State. Oklahoma dropped from first to second and California from second to third. These three States combined produced 738,988,000 barrels of crude petroleum in 1928, or 82 per cent of the total.

The production of the various west Texas fields in 1928 totaled 123,540,000 barrels, or nearly half of the total output of the State, and represented an increase of about 72,000,000 barrels over the 1927 output. Without this increase there would have been a material decrease in the output of the country as a whole. (See figs. 29 and 30.) The most important factor in the rise of west Texas in 1928 was the rapid development of the Hendricks field, of Winkler County. A potential production greater than the total daily output of the entire country was built up in the Yates pool, but the field was curtailed so successfully that the output did not go above 75,000 barrels daily. A deep zone yielding high-gravity oil was discovered at Big Lake in west Texas and the possibilities of the entire Permian Basin were greatly enhanced thereby. Production in southwest Texas increased, but that in the north central, Panhandle, and Gulf coast Texas districts declined. A number of new domes, probably all salt domes, were discovered in the coastal areas of Texas and Louisiana, but their development was not rushed. From the standpoint of production the development of the deep zones in the Long Beach field had first importance in California. Several notable discoveries were made in California in 1928, of which the most important were the final proving of the Kettleman Hills structure after years of wildcatting and the finding of oil at Elwood in an area that had previously been given little attention. A material decline was expected at Seminole in 1928, but this did not occur, because the production of the older pools was fairly well sustained and a number of new productive spots—for example, the St. Louis pool—were opened. The production of Kansas declined in 1928, but the outlook for the State for 1929 was brightened by the discovery of flush production near Wichita in Sedgwick County. The output of Arkansas decreased, as the Champagnolle field, discovered in 1927, was a disappointment. Production in each of the Rocky Mountain States except Wyoming declined. The price advances in the Eastern States stimulated drilling, and output in the majority of these States was higher than in 1927.

Imports of crude petroleum into the United States in 1928 amounted to 79,767,000 barrels, an increase of 37 per cent over 1927 and the largest quantity imported in any year since 1923. Imports of crude petroleum from Mexico again declined and those from Venezuela again increased, with the result that Venezuela displaced Mexico as the chief source of foreign oil. Exports of crude petroleum from the United States and shipments to noncontiguous Territories amounted to 18,966,000 barrels, an increase of 20 per cent over 1927. The increased competition offered by Venezuelan crude had a pronounced effect upon shipments of California crude to eastern ports in the United States, and this movement declined very materially in 1928.

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[1] Work on manuscript completed December, 1929.

[2] Unless otherwise indicated, the tables in this report were prepared by Misses A. B. Coons, M. N. Schellenger, and A. L. Clapp and Mrs. C. S. Evans, of the Bureau of Mines. Figures on imports and exports were compiled by J. A. Dorsey, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.

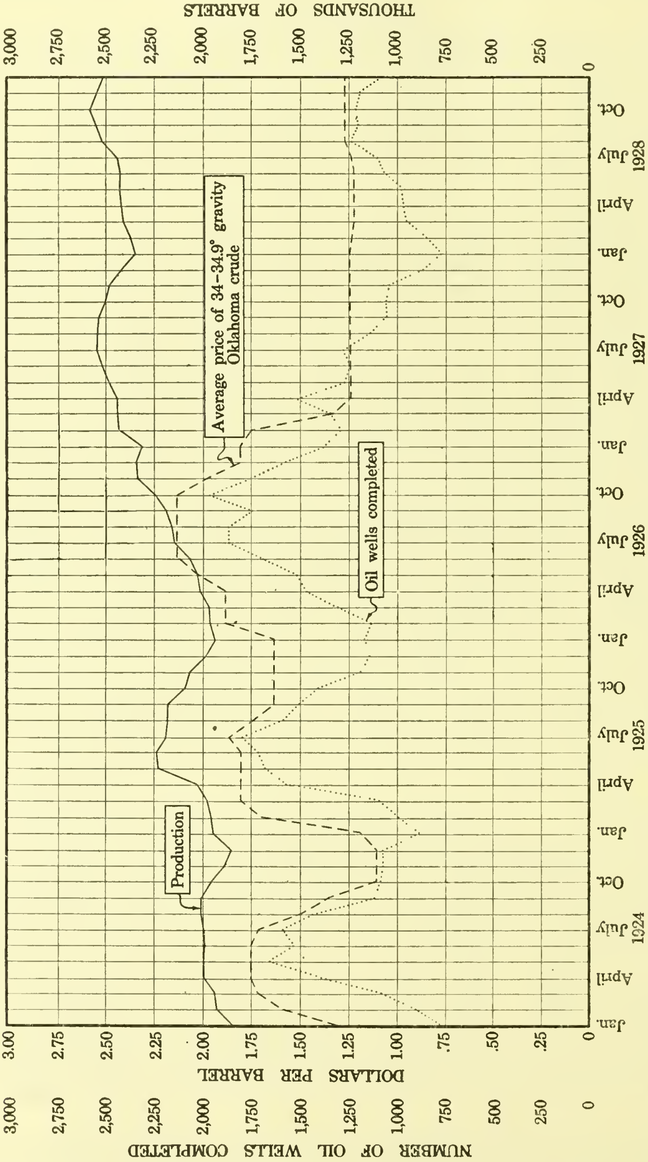

FIGURE 29.—Daily average production of crude petroleum in the United States, total number of oil wells completed, and average price of a selected grade of Oklahoma crude, 1924–1928, by months

A much better balance between supply and demand of crude was maintained in 1928 than in 1927, with the result that in 1928 stocks increased less than 20,000,000 barrels, as compared with an increase of about 70,000,000 barrels in 1927. In general, stocks east of California increased rapidly during the first four months of the year—the period during which production in west Texas was steadily gaining. In California the demand for light or refinable crude exceeded the supply until the deep production at Santa Fe Springs made itself felt in December. Total stocks of crude petroleum (including fuel oil in California) amounted to 490,788,000 barrels on December 31, 1928, as compared with 473,379,000 barrels on January 1, 1928.

The consumption of crude petroleum at refineries continued to increase rapidly in 1928, when a total of 913,295,000 barrels was processed, an increase of 10 per cent over 1927. Runs to stills of domestic crude petroleum amounted to 835,711,000 barrels, an increase of 7 per cent over 1927, and runs of foreign crude totaled 77,584,000 barrels, an increase of 55 per cent. The chief factor in the increased throughput of crude petroleum at refineries in 1928 was the comparable increase in capacity which resulted from the completion of new refineries, particularly in the west Texas area, and from the installation of new equipment. Daily average crude runs to stills increased steadily beginning with February and reached a peak of 2,663,000 barrels in September.

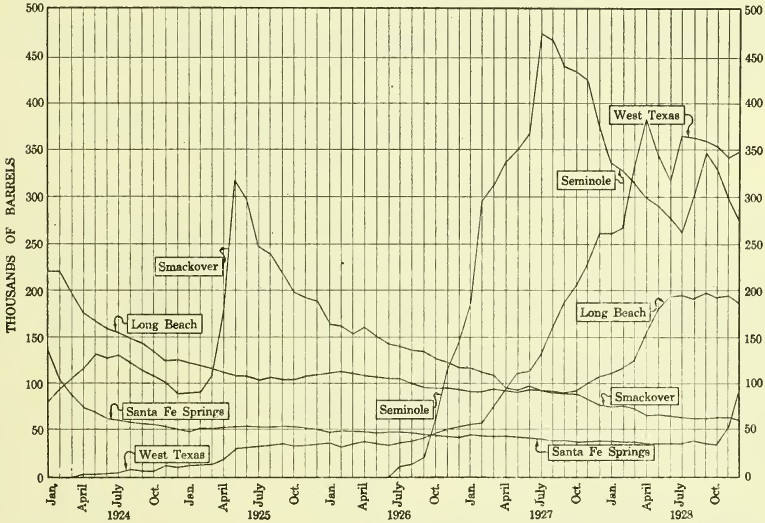

FIGURE 30.—Daily average production of crude petroleum in flush fields, 1924–1928, by months

The total value of the crude petroleum produced in the United States in 1928 amounted to $1,054,880,000, an average of $1.17 per barrel. Although this average represents a decline of $0.13 per barrel from the 1927 average, prices were in reality firmer in 1928 than during 1927. In a few fields, notably the eastern fields, the posted prices for crude advanced materially during the year. In the latter part of July the price of Oklahoma-Kansas and north Texas crudes was raised, the increase varying with gravity but averaging about 10 cents. This increase reflected the heavy demand for Seminole and other high-grade crudes during the summer months. The posted price of west Texas crudes was virtually unchanged throughout the year, although some improvement was reported in new contracts made. The decrease in stocks of light or refinable crude in California was reflected by a price increase of about 25 cents on August 15. Heavy crudes in California remained unchanged at about $0.75 per barrel.

The total number of producing oil wells in the United States, as of December 31, 1928, was 327,800, as compared with 323,300 at the end of 1927. The average production per well per day was 7.6 barrels, as compared with 7.7 barrels in 1927. During 1928 a total of 22,331 wells was completed in the United States, of which 12,526 or 56 per cent were oil wells, 7,078 or 32 per cent were dry holes, and 2,727 or 12 per cent were gas wells. These figures indicate a continued increase in the ratio of dry holes to total completions. A large number of small heavy-oil producers were shut down in California in 1928, and the total number of producing wells in that State declined for the third successive year. The average production per well per day in California increased from 55.9 barrels in 1927 to 57.6 barrels in 1928, and the State easily retained first rank in this respect.

Condensed summary of statistics of crude petroleum, 1924–1928

	1924	1925	1926	1927	1928
Domestic production..........thousands of barrels[1]..	713,940	763,743	770,874	901,129	901,474
Imports..........do....	77,775	61,824	60,382	58,383	79,767
	791,715	825,567	831,256	959,512	981,241
Indicated domestic demand, all oils[2]..........do....	662,205	726,434	779,881	802,946	860,935
Exports (including foreign crude oil)..........do....	17,973	13,335	15,407	15,844	18,962
Added to stocks[3]..........do....	29,349	30,120	[4] 24,764	70,103	22,782
Runs to refinery stills..........do....	643,719	739,920	779,264	828,835	913,295
World production..........do....	1,014,318	1,068,933	1,096,823	1,262,582	1,324,734
United States percentage of world production..........	70	71	70	71	68
Total value of domestic production at wells..........thousands of dollars..	1,022,683	1,284,960	1,447,760	1,172,830	1,054,880
Average price per barrel at wells..........	$1.43	$1.68	$1.88	$1.30	$1.17
Total number of producing oil wells in the United States, Dec. 31..........	299,100	306,100	318,600	323,300	327,800
Total number of oil wells completed in the United States during year..........	14,587	16,559	19,013	14,442	12,526

[1] 42 United States gallons.

[2] Indicated domestic demand for all oils—that is, for crude petroleum, petroleum products, natural gasoline, and benzol.

[3] 1924: Producers', pipe-line, tank-farm, and refinery stocks of domestic and foreign crude petroleum; 1925–1928: All refined products and natural gasoline included.

[4] Decrease.

The total new supply of all oils (production plus imports) in 1928 amounted to 1,038,166,000 barrels (see fig. 31), an increase of 24,082,000 barrels, or 2 per cent over 1927. The total in 1928 was composed of 901,474,000 barrels of domestic crude petroleum, 42,326,000 barrels of natural gasoline, 2,809,000 barrels of benzol, 79,767,000 barrels of imported crude, and 11,790,000 barrels of imported refined oil. Stocks of all oils increased 22,782,000 barrels during the year and amounted to 619,925,000 barrels on December 31, a relatively better showing than in 1927, when 70,103,000 barrels of all oils was added to storage. Total exports (including shipments to noncontiguous Territories) of crude petroleum and refined products in 1928 amounted to 154,449,000 barrels, which, when deducted from the total new supply minus the stock increase, gives a total indicated domestic demand of 860,935,000 barrels. This total compares with 802,946,000 barrels in 1927, a gain of 57,989,000 barrels, or 7 per cent.

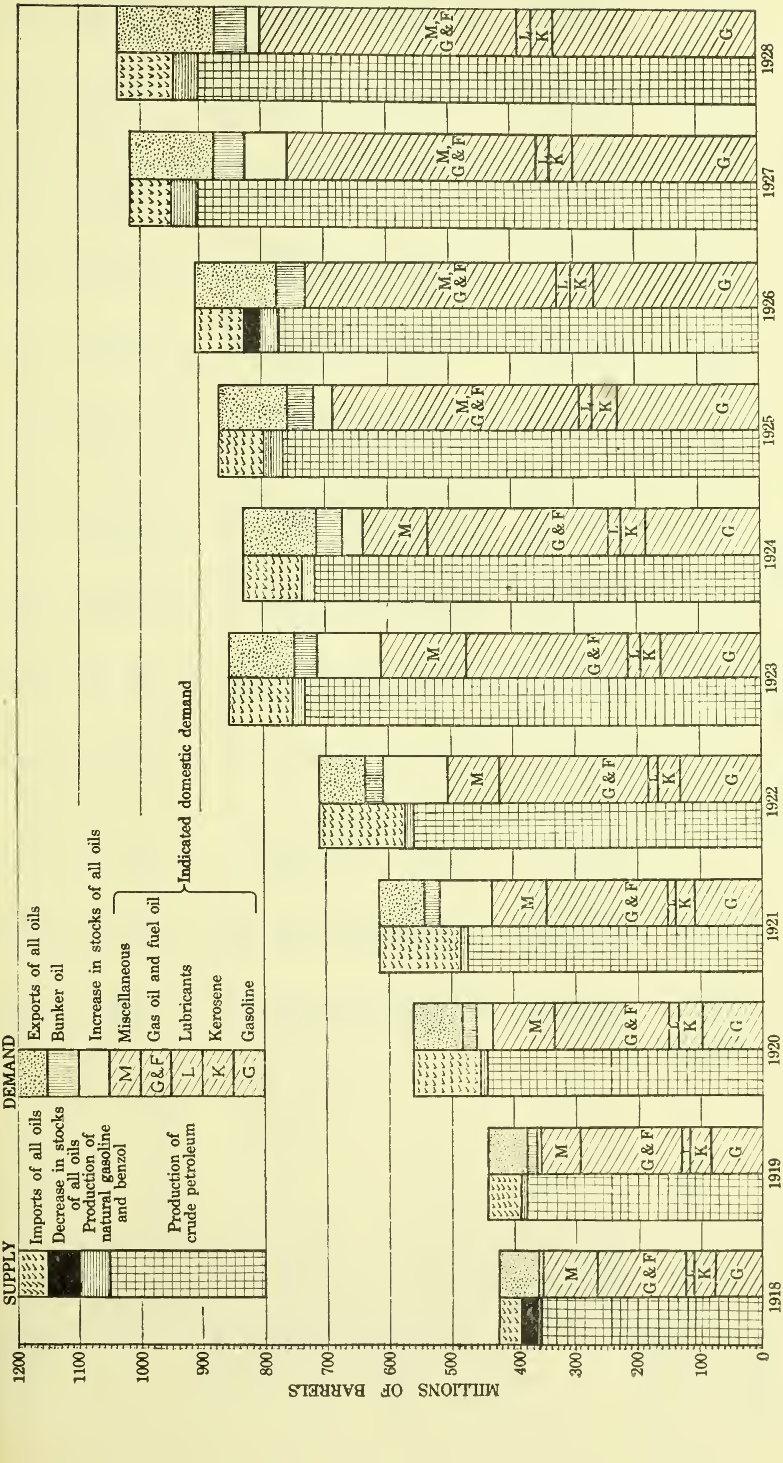

FIGURE 31.—Supply and demand of all oils, 1918–1928

Summary of supply and demand of all oils (including wax, coke, and asphalt), 1927 and 1928, by months

[Thousands of barrels of 42 U. S. gallons]

	January	February	March	April	May	June	July	August	September	October	November	December	The year
1927													
New supply:													
Domestic production—													
Crude petroleum	71,758	68,122	75,514	73,132	76,845	75,303	78,780	78,788	75,909	77,534	74,493	74,951	901,129
Daily average	2,315	2,433	2,436	2,438	2,479	2,510	2,541	2,542	2,530	2,501	2,483	2,418	2,469
Natural gasoline	3,145	2,933	3,272	3,172	3,219	3,093	3,119	3,214	3,245	3,419	3,393	3,433	38,657
Benzol	217	200	226	216	221	210	214	214	210	217	205	212	2,562
Total	75,120	71,255	79,012	76,520	80,285	78,606	82,113	82,216	79,364	81,170	78,091	78,596	942,348
Daily average	2,423	2,545	2,549	2,551	2,590	2,620	2,649	2,652	2,645	2,618	2,603	2,535	2,582
Imports—													
Crude petroleum	4,593	4,181	4,582	4,063	4,557	4,019	4,823	6,261	5,122	4,633	5,339	6,210	58,383
Refined products	1,189	1,507	1,027	1,201	1,329	1,448	1,053	774	868	1,042	1,159	756	13,353
Total new supply, all oils	80,902	76,943	84,621	81,784	86,171	84,073	87,989	89,251	85,354	86,845	84,589	85,562	1,014,084
Daily average	2,610	2,748	2,730	2,726	2,780	2,802	2,838	2,879	2,845	2,801	2,820	2,760	2,778
Increase in stocks, all oils	8,279	9,039	8,485	8,054	5,881	4,370	7,875	1,858	1,860	3,695	7,300	3,407	70,103
Demand:													
Total demand	72,623	67,904	76,136	73,730	80,290	79,703	80,114	87,393	83,494	83,150	77,289	82,155	943,981
Daily average	2,343	2,425	2,456	2,458	2,590	2,657	2,584	2,819	2,783	2,682	2,576	2,650	2,586
Exports [1]—													
Crude petroleum	1,204	1,165	1,199	1,171	1,390	1,411	1,089	1,382	1,297	1,539	1,280	1,717	15,844
Refined products	10,051	9,636	9,450	9,940	11,868	11,311	10,080	11,758	9,652	11,554	10,525	9,366	125,191
Domestic demand [2]	61,368	57,103	65,487	62,619	67,032	66,981	68,945	74,253	72,545	70,057	65,484	71,072	802,946
Daily average	1,980	2,039	2,112	2,087	2,162	2,233	2,224	2,395	2,418	2,260	2,183	2,293	2,200
Excess daily average domestic production over domestic demand	443	506	437	464	428	387	425	257	227	358	420	242	382
Stocks (end of month):													
Crude petroleum—													
East of California—													
Pipe-line, tank-farm, refinery, and importers'	279,302	286,266	291,142	298,819	306,967	315,464	324,378	333,413	339,472	345,864	350,487	352,038	352,038
Producers'	5,934	5,967	6,001	6,040	6,073	6,112	6,229	6,473	6,813	7,066	7,256	7,536	7,536
California—													
Light	31,017	29,770	29,568	29,460	27,143	26,898	25,301	23,262	22,826	21,676	21,273	20,086	20,086
Heavy [3]	89,043	88,834	89,103	89,537	91,407	91,964	93,011	93,353	93,820	92,233	93,880	93,719	93,719
Total [3]	405,296	410,837	415,814	423,856	431,590	440,438	448,919	456,501	462,931	466,839	472,896	473,379	473,379
Natural gasoline at plants	560	619	697	788	926	971	992	846	736	781	820	734	734
Refined products	129,463	132,902	136,332	136,253	134,262	129,739	129,112	123,534	119,074	118,816	120,020	123,030	123.030
Grand total stocks, all oils	535,319	544,358	552,843	560,897	566,778	571,148	579,023	580,881	582,741	586,436	593,736	597,143	597,143

Days supply [4]	228	224	225	228	219	215	224	206	209	219	230	225	231
Bunker oil	3, 940	3, 587	3, 874	4, 204	4, 251	4, 244	4, 077	4, 470	4, 436	4, 594	4, 110	4, 264	50, 051
1928													
New supply:													
Domestic production—													
Crude petroleum	72, 793	68, 565	74, 528	72, 393	75, 277	72, 676	75, 584	77, 807	76, 484	79, 751	76, 123	79, 493	901, 474
Daily average	2, 348	2, 364	2, 404	2, 413	2, 428	2, 423	2, 438	2, 510	2, 549	2, 573	2, 537	2, 564	2, 463
Natural gasoline	3, 414	3, 326	3, 474	3, 464	3, 493	3, 364	3, 436	3, 438	3, 488	3, 731	3, 769	3, 929	42, 326
Benzol	226	216	239	229	238	231	229	233	231	245	240	252	2, 809
Total	76, 433	72, 107	78, 241	76, 086	79, 008	76, 271	79, 249	81, 478	80, 203	83, 727	80, 132	83, 674	946, 609
Daily average	2, 466	2, 486	2, 524	2, 536	2, 549	2, 542	2, 556	2, 628	2, 673	2, 701	2, 671	2, 699	2, 586
Imports—													
Crude petroleum	6, 330	6, 036	6, 845	5, 661	6, 766	6, 553	7, 878	6, 141	7, 139	6, 703	6, 908	6, 807	79, 767
Refined products	1, 165	1, 055	1, 134	1, 680	1, 162	712	782	1, 007	598	771	728	996	11, 790
Total new supply, all oils	83, 928	79, 198	86, 220	83, 427	86, 936	83, 536	87, 909	88, 626	87, 940	91, 201	87, 768	91, 477	1, 038, 166
Daily average	2, 707	2, 731	2, 781	2, 781	2, 804	2, 785	2, 836	2, 859	2, 931	2, 942	2, 926	2, 951	2, 837
Increase in stocks, all oils	10, 451	6, 875	5, 919	2, 982	414	[5] 883	[5] 3, 687	[5] 2, 886	[5] 2, 409	39	1, 145	4, 822	22, 782
Demand:													
Total demand	73, 477	72, 323	80, 301	80, 445	86, 522	84, 419	91, 596	91, 512	90, 349	91, 162	86, 623	86, 655	1, 015, 384
Daily average	2, 370	2, 494	2, 590	2, 682	2, 791	2, 814	2, 955	2, 952	3, 012	2, 941	2, 887	2, 795	2, 774
Exports [1]—													
Crude petroleum	1, 225	1, 243	1, 530	1, 303	1, 493	1, 879	1, 669	1, 883	1, 506	2, 015	1, 691	1, 529	18, 966
Refined products	11, 747	9, 598	11, 250	11, 810	13, 018	12, 222	12, 731	10, 810	11, 288	10, 271	11, 299	9, 439	135, 483
Domestic demand [2]	60, 505	61, 482	67, 521	67, 332	72, 011	70, 318	77, 196	78, 819	77, 555	78, 876	73, 633	75, 687	860, 935
Daily average	1, 952	2, 120	2, 178	2, 244	2, 323	2, 344	2, 490	2, 543	2, 585	2, 544	2, 454	2, 442	2, 352
Excess of daily average domestic production over domestic demand	514	366	346	292	226	198	66	85	88	157	217	257	234
Stocks (end of month):													
Crude petroleum—													
East of California—													
Pipe-line, tank-farm, refinery, and importers'	359, 363	363, 859	369, 439	372, 077	372, 017	371, 475	369, 474	368, 707	366, 720	367, 949	367, 622	368, 353	368, 353
Producers'	7, 450	7, 370	7, 284	7, 201	7, 115	7, 032	6, 946	6, 860	6, 777	6, 691	6, 608	6, 521	6, 521
California—													
Light	20, 562	20, 142	19, 579	18, 782	19, 470	19, 197	18, 215	18, 310	16, 870	16, 684	16, 524	16, 995	16, 995
Heavy [3]	94, 337	94, 828	94, 516	94, 359	93, 871	94, 234	95, 663	95, 057	96, 563	97, 025	97, 439	98, 919	98, 919
Total [3]	481, 712	486, 199	490, 818	492, 419	492, 473	491, 938	490, 298	488, 934	486, 930	488, 349	488, 193	490, 788	490, 788
Natural gasoline at plants	740	824	843	831	810	648	476	414	436	402	405	607	607
Refined products	125, 142	127, 446	128, 727	130, 120	130, 501	130, 315	128, 440	126, 980	126, 553	125, 207	126, 505	128, 530	128, 530
Grand total stocks, all oils	607, 594	614, 469	620, 388	623, 370	623, 784	622, 901	619, 214	616, 328	613, 919	613, 958	615, 103	619, 925	619, 925
Days supply [4]	256	246	240	232	223	221	210	209	204	209	213	222	223
Bunker oil	3, 930	3, 751	4, 236	4, 275	5, 013	4, 307	4, 116	4, 564	4, 053	4, 558	4, 235	4, 188	51, 226

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[1] Includes shipments to noncontiguous Territories.
[2] Inclusive of bunker oil, loaded on vessels engaged in foreign trade, for which see below.
[3] Includes fuel oil in California.
[4] Grand total stocks, all oils, divided by daily average total demand.
[5] Decrease.

PRODUCTION

DOMESTIC PRODUCTION

BY MONTHS

Daily average production for 1928 was at its lowest in January; it increased quite steadily thereafter until the peak was reached in October. The total production during October was 79,751,000 barrels, compared with 78,788,000 barrels for the high month (August) of 1927, when Seminole was at its peak.

Petroleum produced in the United States, 1924–1928, by months

[Thousands of barrels of 42 U. S. gallons]

Year	January	February	March	April	May	June	July	August	September	October	November	December	The year
1924	57, 273	55, 889	60, 141	59, 830	61, 834	59, 583	61, 932	62, 398	60, 376	60, 469	56, 782	57, 433	713, 940
1925	60, 400	54, 775	61, 339	62, 048	68, 850	67, 240	67, 763	67, 580	65, 432	64, 842	61, 927	61, 547	763, 743
1926	59, 981	54, 892	60, 880	60, 371	62, 822	61, 789	65, 168	67, 009	65, 782	69, 664	69, 891	72, 625	770, 874
1927	71, 758	68, 122	75, 514	73, 132	76, 845	75, 303	78, 780	78, 788	75, 909	77, 534	74, 493	74, 951	901, 129
1928	72, 793	68, 565	74, 528	72, 393	75, 277	72, 676	75, 584	77, 807	76, 484	79, 751	76, 123	79, 493	901, 474

BY FIELDS OR DISTRICTS

The production of the Mid-Continent field in 1928 amounted to 553,125,000 barrels, an increase over 1927 of about 6,000,000 barrels. This increase was more than enough to compensate for the losses sustained in a few of the less important districts.

Petroleum produced in the United States, 1927 and 1928, by fields

[Thousands of barrels of 42 U. S. gallons]

Field	January	February	March	April	May	June	July	August	September	October	November	December	The year		
														Value at wells	
													Quantity	Total (thousands of dollars)	Average per barrel
1927															
Appalachian	2,330	2,318	2,675	2,539	2,612	2,604	2,547	2,692	2,586	2,592	2,529	2,430	30,454	76,880	$2.52
Lima-Indiana	140	156	170	156	161	171	156	159	153	153	131	129	1,835	3,260	1.78
Michigan	29	29	38	40	40	42	38	41	38	38	33	33	439	832	1.90
Illinois and southwestern Indiana	644	617	753	589	660	662	636	673	640	623	626	597	7,720	12,900	1.67
Mid-Continent	40,942	40,362	44,748	43,215	46,610	45,646	[1] 48,955	[1] 49,146	[1] 46,911	[1] 48,054	46,295	46,119	[1] 547,003	[1] 708,961	1.30
Gulf coast [2]	4,831	4,200	4,580	4,367	4,524	4,427	[1] 4,296	[1] 4,226	[1] 4,151	[1] 4,254	4,013	4,184	[1] 52,053	[1] 67,229	1.29
Rocky Mountain [3]	2,650	2,450	2,706	2,725	2,724	2,563	2,766	2,504	2,299	2,303	2,285	2,454	30,429	42,033	1.38
California [4]	20,192	17,990	19,844	19,501	19,514	19,188	19,386	19,347	19,131	19,517	18,581	19,005	231,196	260,735	1.13
	71,758	68,122	75,514	73,132	76,845	75,303	78,780	78,788	75,909	77,534	74,493	74,951	901,129	1,172,830	1.30
Daily average	2,315	2,433	2,436	2,438	2,479	2,510	2,541	2,542	2,530	2,501	2,483	2,418	2,469	----------	---------
1928															
Appalachian	2,402	2,414	2,647	2,512	2,764	2,568	2,667	2,722	2,472	2,776	2,552	2,563	31,059	82,320	2.65
Lima-Indiana	124	131	145	137	163	157	159	145	129	141	116	123	1,670	2,630	1.57
Michigan	31	30	29	37	46	50	56	46	37	73	88	71	594	920	1.55
Illinois and southwestern Indiana	580	591	706	543	654	628	632	659	588	646	595	603	7,425	11,450	1.54
Mid-Continent	44,560	41,825	45,624	44,901	45,719	43,610	45,707	48,005	48,088	50,124	46,716	48,246	553,125	634,550	1.15
Gulf coast [2]	3,717	3,322	3,725	3,632	4,075	4,033	4,155	4,150	3,843	4,024	3,848	4,067	46,591	55,150	1.18
Rocky Mountain [3]	2,410	2,186	2,570	2,339	2,548	2,435	2,471	2,581	2,422	2,586	2,352	2,299	29,199	37,860	1.30
California [4]	18,969	18,066	19,082	18,292	19,308	19,195	19,737	19,499	18,905	19,381	19,856	21,521	231,811	230,000	.99
	72,793	68,565	74,528	72,393	75,277	72,676	75,584	77,807	76,484	79,751	76,123	79,493	901,474	1,054,880	1.17
Daily average	2,348	2,364	2,404	2,413	2,428	2,423	2,438	2,510	2,549	2,573	2,537	2,564	2,463	----------	---------

[1] Revised figures.

[2] Salt-dome pools.

[3] Includes Alaska.

[4] Annual and semiannual figures from Division of Mines and Mining, Department of Natural Resources, California. Monthly figures prorated on basis of monthly reports by the American Petroleum Institute.

BY STATES

Texas, which ranked third in production in 1927, rose to first place in 1928 (see fig. 32), displacing Oklahoma and causing California to drop from second to third. Kentucky moved from eleventh to ninth place, and Indiana moved from seventeenth to sixteenth and displaced New Mexico.

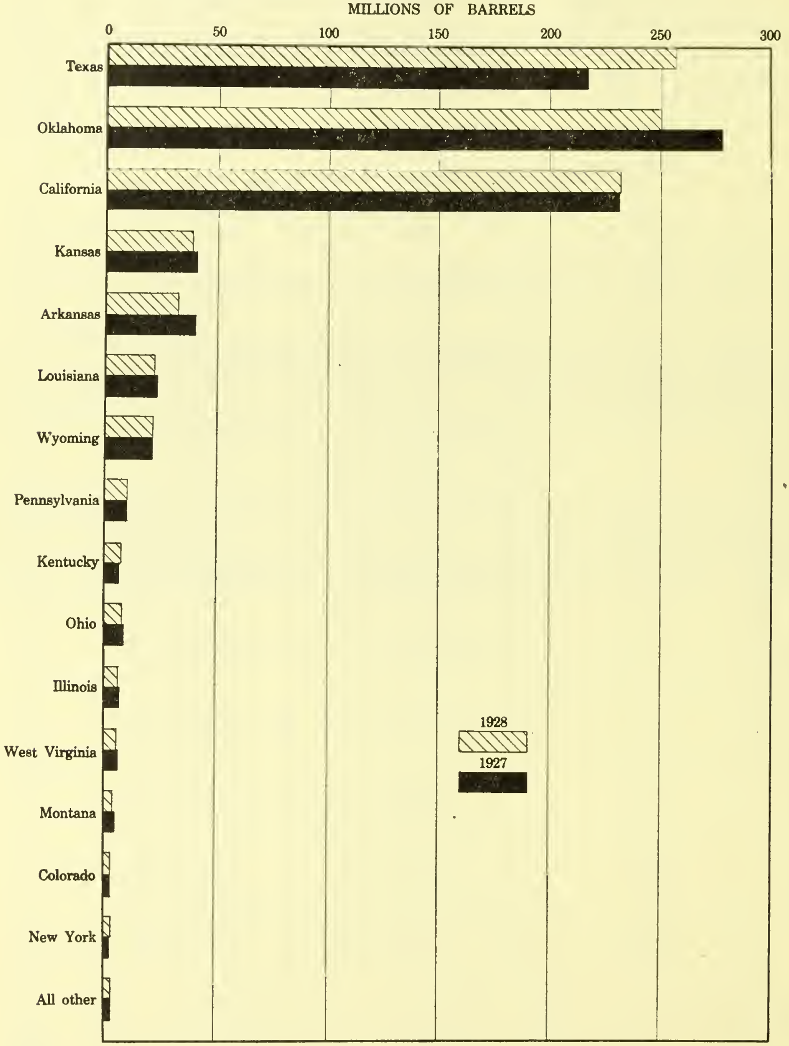

FIGURE 32.—Production of crude petroleum, 1927 and 1928, by States

Petroleum produced in the United States,

[Thousands of barrels

Year	New York	Pennsylvania	Ohio	West Virginia	California	Kentucky	Tennessee	Colorado	Indiana	Illinois	Kansas
1859-1875	(2)	[2] 74,072	------	------	------	------	------	------	------	------	------
1876	(2)	[2] 8,969	32	120	12	------	------	------	------	------	------
1877	(2)	[2] 13,135	30	172	13	------	------	------	------	------	------
1878	(2)	[2] 15,164	38	180	15	------	------	------	------	------	------
1879	(2)	[2] 19,685	29	180	20	------	------	------	------	------	------
1880	(2)	[2] 26,028	39	179	40	------	------	------	------	------	------
1881	(2)	[2] 27,376	34	151	100	------	------	------	------	------	------
1882	6,685	23,368	40	128	129	------	------	------	------	------	------
1883	4,004	19,125	47	126	143	[3] 5	(3)	------	------	------	------
1884	3,231	20,541	90	90	262	[3] 4	(3)	------	------	------	------
1885	2,658	18,118	662	91	325	[3] 5	(3)	------	------	------	------
1886	2,151	23,647	1,783	102	377	[3] 5	(3)	------	------	------	------
1887	2,075	20,281	5,023	145	678	[3] 5	(3)	76	------	------	------
1888	(2)	[2] 16,489	10,011	119	690	[3] 5	(3)	298	------	------	------
1889	1,897	19,591	12,472	544	303	[3] 5	(3)	317	33	1	1
1890	(2)	[2] 28,458	16,125	493	307	[3] 6	(3)	369	64	1	1
1891	1,585	31,424	17,740	2,406	324	[3] 9	(3)	666	137	1	1
1892	1,273	27,149	16,363	3,810	385	[3] 7	(3)	824	698	1	5
1893	1,032	19,283	16,249	8,446	470	[3] 3	(3)	594	2,335	1	18
1894	942	18,078	16,792	8,577	706	[3] 2	(3)	516	3,689	(4)	40
1895	913	18,231	19,545	8,120	1,209	[3] 2	(3)	438	4,386	(4)	44
1896	1,205	19,379	23,941	10,020	1,253	[3] 2	(3)	361	4,681	(4)	114
1897	1,279	17,983	21,561	13,090	1,903	(3 4)	(3)	385	4,122	1	81
1898	1,205	14,743	18,739	13,615	2,257	[3] 6	(3)	444	3,731	(4)	72
1899	1,321	13,054	21,142	13,911	2,642	[3] 18	(3)	390	3,848	(4)	70
1900	1,301	13,258	22,363	16,196	4,325	[3] 62	(3)	317	4,874	(4)	75
1901	1,207	12,625	21,648	14,177	8,787	[3] 137	(3)	461	5,757	(4)	179
1902	1,120	12,064	21,014	13,513	13,984	[3] 185	(3)	397	7,481	(4)	332
1903	1,163	11,355	20,480	12,900	24,382	[3] 554	(3)	484	9,186	------	932
1904	1,113	11,126	18,877	12,645	29,649	[3] 998	(3)	501	11,339	------	4,251
1905	1,118	10,437	16,347	11,578	33,428	[3] 1,217	(3)	376	10,964	181	[6] 12,014
1906	1,243	10,257	14,788	10,121	33,099	[3] 1,214	(3)	328	7,674	4,397	[6] 21,718
1907	1,212	10,000	12,207	9,095	39,748	[3] 821	(3)	332	5,128	24,282	2,410
1908	1,160	9,424	10,859	9,523	44,855	728	------	380	3,283	33,686	1,801
1909	1,135	9,299	10,633	10,745	55,472	639	------	311	2,296	30,898	1,264
1910	1,054	8,795	9,916	11,753	73,011	469	------	240	2,160	33,143	1,128
1911	953	8,248	8,817	9,796	81,134	472	------	227	1,695	31,317	1,279
1912	874	7,838	8,969	12,129	87,269	484	------	206	970	28,602	1,593
1913	948	7,917	8,781	11,567	97,788	525	------	189	956	23,894	2,375
1914	939	8,170	8,536	9,680	99,775	503	------	223	1,336	21,920	3,104
1915	888	7,838	7,825	9,265	86,592	437	------	208	876	19,042	2,823
1916	874	7,593	7,744	8,731	90,952	1,202	1	197	769	17,714	8,738
1917	880	7,733	7,751	8,379	93,878	3,088	12	121	760	15,777	36,536
1918	809	7,408	7,285	7,867	97,532	4,368	8	143	878	13,366	45,451
1919	851	8,137	7,736	8,327	101,183	9,278	15	121	972	11,960	33,048
1920	906	7,438	7,400	8,249	103,377	8,738	14	111	945	10,774	39,005
1921	988	7,418	7,335	7,822	112,600	9,013	12	108	1,158	10,043	36,456
1922	1,000	7,425	6,781	7,021	138,468	8,973	10	97	1,087	9,383	31,766
1923	1,250	7,609	7,085	6,358	262,876	8,069	8	86	1,043	8,707	28,250
1924	1,440	7,486	6,811	5,920	228,933	7,407	10	445	935	8,081	28,836
1925	1,695	8,097	7,212	5,763	232,492	6,759	24	1,226	829	7,863	38,357
1926	1,956	8,961	7,272	5,946	224,673	6,274	43	2,768	808	7,760	41,498
1927	2,242	9,526	7,593	6,023	231,196	6,719	60	2,831	852	6,994	41,069
1928	2,603	9,956	7,015	5,661	231,811	7,359	46	2,774	1,052	6,462	38,596
	[7] 68,378	[7] 816,809	535,607	361,565	2,977,832	[3] 96,781	[3] 263	21,886	115,787	386,252	[6] 505,331
Percentage of total production	0.3	1.1	0.8	0.6	25.7	0.8	------	0.3	0.1	0.7	4.3

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[1] 1889-1899, Missouri; 1900-1906, Michigan and Missouri; 1907-1911, Michigan, Missouri, and Utah; 1912, 1917, 1918, Alaska and Michigan; 1913 and 1919, Alaska, Michigan, Missouri, and New Mexico; 1914-1916, Alaska, Michigan, and Missouri; 1920, Alaska, Arkansas, Missouri, New Mexico, and Utah; 1921-1923, Alaska, Missouri, and New Mexico; 1924-1928, Alaska and Utah.

[2] New York included with Pennsylvania.

[3] Tennessee included with Kentucky, 1883 to 1907, inclusive.

1859–1928, by States

of 42 U. S. gallons]

Texas	Oklahoma	Wyoming	Michigan	Louisiana	New Mexico	Montana	Arkansas	Other[1]	Total		
									Quantity	Value at wells	
										Total (thousands of dollars)	Average per barrel
------	------	------	------	------	------	------	------	------	74,072	215,781	$2.91
------	------	------	------	------	------	------	------	------	9,133	22,983	2.52
------	------	------	------	------	------	------	------	------	13,350	31,789	2.38
------	------	------	------	------	------	------	------	------	15,397	18,045	1.17
------	------	------	------	------	------	------	------	------	19,914	17,211	.86
------	------	------	------	------	------	------	------	------	26,286	24,601	.94
------	------	------	------	------	------	------	------	------	27,661	25,448	.92
------	------	------	------	------	------	------	------	------	30,350	23,631	.78
------	------	------	------	------	------	------	------	------	23,450	25,790	1.10
------	------	------	------	------	------	------	------	------	24,218	20,596	.85
------	------	------	------	------	------	------	------	------	21,859	19,198	.88
------	------	------	------	------	------	------	------	------	28,065	19,996	.71
------	------	------	------	------	------	------	------	------	28,283	18,877	.67
------	------	------	------	------	------	------	------	------	27,612	17,948	.65
(4)	------	------	------	------	------	------	------	(4)	35,164	26,963	.77
(4)	------	------	------	------	------	------	------	(4)	45,824	35,365	.77
(4)	(4)	------	------	------	------	------	------	(4)	54,293	30,527	.56
(4)	(4)	------	------	------	------	------	------	(4)	50,515	25,907	.51
(4)	(4)	------	------	------	------	------	------	(4)	48,431	28,950	.60
(4)	(4)	2	------	------	------	------	------	(4)	49,344	35,522	.72
(4)	(4)	4	------	------	------	------	------	(4)	52,892	57,632	1.09
1	(4)	3	------	------	------	------	------	(4)	60,960	58,519	.96
66	1	4	------	------	------	------	------	(4)	60,476	40,874	.68
546	------	6	------	------	------	------	------	(4)	55,364	44,193	.80
669	------	6	------	------	------	------	------	(4)	57,071	64,604	1.13
836	6	6	(5)	------	------	------	------	2	63,621	75,989	1.19
4,394	10	5	(5)	------	------	------	------	2	69,389	66,417	.96
18,084	37	6	(5)	549	------	------	------	1	88,767	71,179	.80
17,956	139	9	(5)	918	------	------	------	3	100,461	94,694	.94
22,241	1,367	12	(5)	2,959	------	------	------	3	117,081	101,175	.86
28,136	(6)	8	(5)	8,910	------	------	------	3	134,717	84,157	.62
12,568	(6)	7	(5)	9,077	------	------	------	3	126,494	92,445	.73
12,323	43,524	9	(5)	5,000	------	------	------	4	166,095	120,107	.72
11,207	45,799	18	(5)	5,789	------	------	------	15	178,527	129,079	.72
9,534	47,859	20	(5)	3,060	------	------	------	6	183,171	128,329	.70
8,899	52,029	115	(5)	6,841	------	------	------	4	209,557	127,900	.61
9,526	56,069	187	(5)	10,721	------	------	------	8	220,449	134,045	.61
11,735	51,427	1,572	(5)	9,263	------	------	------	4	222,935	164,213	.74
15,010	63,579	2,407	(5)	12,499	(5)	------	------	11	248,446	237,121	.95
20,068	73,632	3,560	(5)	14,309	------	------	------	8	265,763	214,125	.81
24,943	97,915	4,246	(5)	18,192	------	------	------	14	281,104	179,463	.64
27,645	107,072	6,234	(5)	15,248	------	45	------	8	300,767	330,900	1.10
32,413	107,508	8,978	(5)	11,392	------	100	------	10	335,316	522,635	1.56
38,750	103,347	12,596	(5)	16,043	------	69	------	8	355,928	703,944	1.98
79,366	86,911	13,172	(5)	17,188	(5)	90	------	12	378,367	760,266	2.01
96,868	106,206	16,831	------	35,714	(5)	340	(5)	13	442,929	1,360,745	3.07
106,166	114,634	19,333	------	27,103	(5)	1,509	10,473	12	472,183	814,745	1.73
118,684	149,571	26,715	------	35,376	(5)	2,449	12,712	13	557,531	895,111	1.61
131,023	160,929	44,785	------	24,919	(5)	2,782	36,610	18	732,407	978,430	1.34
134,522	173,538	39,498	------	21,124	98	2,815	46,028	13	713,940	1,022,683	1.43
144,648	176,768	29,173	4	20,272	1,060	4,091	77,398	12	763,743	1,284,960	1.68
166,916	179,195	25,776	94	23,201	1,666	7,727	58,332	8	770,874	1,447,760	1.88
217,389	277,775	21,307	439	22,818	1,226	5,058	40,005	7	901,129	1,172,830	1.30
257,320	249,857	21,461	594	21,847	943	4,015	32,096	6	901,474	1,054,880	1.17
1,780,452	[6]2,526,704	298,071	[8]1,131	400,332	[9]4,993	31,090	313,654	231	11,243,149	15,321,277	------
28.5	27.7	2.4	0.1	2.4	0.1	0.5	3.6	------	100.0	------	------

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[4] Less than 500 barrels. (See Mineral Resources, 1916, pt. 2, pp. 684–685.)

[5] Included under "Other."

[6] Oklahoma included with Kansas in 1905 and 1906.

[7] Early production in New York included with Pennsylvania.

[8] Figures represent 1925–1928 production only. Earlier years included under "Other."

[9] Figures represent 1924–1928 production only. Earlier years included under "Other."

Petroleum produced in the United States, 1927 and 1928, by States

[Thousands of barrels of 42 U. S. gallons]

	January	February	March	April	May	June	July	August	September	October	November	December	The year	Value at wells (thousands of dollars)
1927														
Arkansas	4, 042	3, 540	3, 825	3, 284	3, 465	3, 313	3, 303	3, 242	3, 081	3, 175	2, 912	2, 823	40, 005	42, 400
California [1]	20, 192	17, 990	19, 844	19, 501	19, 514	19, 188	19, 386	19, 347	19, 131	19, 517	18, 581	19, 005	231, 196	260, 735
Colorado	237	225	248	303	246	220	245	233	211	221	222	220	2, 831	3, 400
Illinois	589	558	698	536	601	602	576	607	577	557	562	531	6, 994	11, 700
Indiana:														
Southwestern	55	59	55	53	59	60	60	66	63	66	64	66	726	1, 200
Northeastern	9	12	12	12	12	13	11	10	10	9	8	8	126	190
Total Indiana	64	71	67	65	71	73	71	76	73	75	72	74	852	1, 390
Kansas	3, 575	3, 342	3, 608	3, 496	3, 586	3, 452	3, 374	3, 357	3, 283	3, 441	3, 277	3, 278	41, 069	58, 300
Kentucky	509	490	549	540	559	558	586	612	587	588	586	555	6, 719	11, 220
Louisiana:														
Gulf Coast [2]	322	290	447	477	453	457	458	434	414	432	419	447	5, 050	6, 110
Northern	1, 587	1, 448	1, 531	1, 423	1, 422	1, 426	1, 573	1, 597	1, 488	1, 495	1, 382	1, 396	17, 768	23, 630
Total Louisiana	1, 909	1, 738	1, 978	1, 900	1, 875	1, 883	2, 031	2, 031	1, 902	1, 927	1, 801	1, 843	22, 818	29, 740
Michigan	29	29	38	40	40	42	38	41	38	38	33	33	439	832
Montana	410	399	448	413	456	476	468	457	417	406	365	343	5, 058	7, 090
New Mexico	133	138	143	148	102	92	87	83	74	66	78	82	1, 226	1, 680
New York	169	169	195	185	191	189	184	200	192	189	187	192	2, 242	7, 110
Ohio:														
Central and eastern	454	453	536	502	527	512	487	518	492	482	473	448	5, 884	11, 900
Northwestern	131	144	158	144	149	158	145	149	143	144	123	121	1, 709	3, 070
Total Ohio	585	597	694	646	676	670	632	667	635	626	596	569	7, 593	14, 970
Oklahoma	18, 596	19, 951	22, 341	21, 407	23, 400	23, 516	26, 810	26, 377	24, 424	24,704	23, 767	22, 482	277, 775	397, 200
Pennsylvania	718	728	842	799	812	824	789	830	805	820	793	766	9, 526	29, 150
Tennessee	5	4	3	4	5	4	5	9	5	6	6	4	60	90
Texas:														
Gulf coast [2]	4, 509	3, 910	4, 133	3, 890	4, 071	3, 970	[3] 3, 838	[3] 3, 792	[3] 3, 737	[3] 3, 822	3, 594	3, 737	[3] 47, 003	[3] 61, 119
West Texas	1, 768	1, 803	2, 351	2, 782	3, 429	3, 433	4, 100	4, 965	5, 610	6, 397	6, 767	8, 133	51, 538	41, 327
Rest of State	11, 374	10, 278	11, 092	10, 823	11, 308	10, 506	[3] 9, 795	[3] 9, 608	[3] 9, 025	[3] 8, 842	8, 190	8, 007	[3] 118, 848	[3] 146, 104
Total Texas	17, 651	15, 991	17, 576	17, 495	18, 808	17, 909	17, 733	18, 365	18, 372	19, 061	18, 551	19, 877	217, 389	248, 550

West Virginia	475	474	550	509	518	517	496	523	505	507	484	465	6, 023	17, 410
Wyoming	1, 870	1, 688	1, 867	1, 860	1, 919	1, 774	1, 965	1, 730	1, 596	1, 609	1, 620	1, 809	21, 307	29, 830
Other [4]	----------	----------	----------	1	1	1	1	1	1	1	----------	----------	7	33
United States	71, 758	68, 122	75, 514	73, 132	76, 845	75, 303	78, 780	78, 788	75, 909	77, 534	74, 493	74, 951	901, 129	1, 172, 830
Daily average	2, 315	2, 433	2, 436	2, 438	2, 479	2, 510	2, 541	2, 542	2, 530	2, 501	2, 483	2, 418	2, 469	----------
Classified by gravity (approximately):														
Light	61, 564	59, 061	65, 494	63, 565	67, 283	65, 862	69, 121	69, 345	66, 911	68, 277	65, 884	66, 427	788, 794	1, 172, 830
Heavy	10, 194	9, 061	10, 020	9, 567	9, 562	9, 441	9, 659	9, 443	8, 998	9, 257	8, 609	8, 524	112, 335	
United States	71, 758	68, 122	75, 514	73, 132	76, 845	75, 303	78, 780	78, 788	75, 909	77, 534	74, 493	74, 951	901, 129	1, 172, 830
1928														
Arkansas	2, 716	2, 569	2, 699	2, 396	2, 826	3, 070	2, 791	2, 682	2, 556	2, 647	2, 601	2, 543	32, 096	27, 450
California [1]	18, 969	18, 066	19, 082	18, 292	19, 308	19, 195	19, 737	19, 499	18, 905	19, 381	19, 856	21, 521	231, 811	230, 000
Colorado	224	232	264	224	226	229	252	245	212	232	221	213	2, 774	2, 750
Illinois	510	516	635	468	573	550	551	573	506	558	508	514	6, 462	9, 980
Indiana:														
Southwestern	70	75	71	75	81	78	81	86	82	88	87	89	963	1, 470
Northeastern	7	8	7	8	9	8	7	8	7	8	6	6	89	110
Total Indiana	77	83	78	83	90	86	88	94	89	96	93	95	1, 052	1, 580
Kansas	3, 362	3, 248	3, 561	3, 422	3, 444	3, 274	3, 283	3, 222	2, 912	3, 073	2, 828	2, 967	38, 596	52, 500
Kentucky	542	558	623	618	653	563	681	662	594	660	608	597	7, 359	11, 850
Louisiana:														
Gulf coast [2]	434	431	477	439	487	774	797	796	644	575	580	619	7, 053	8, 150
Northern	1, 374	1, 265	1, 302	1, 307	1, 343	1, 221	1, 219	1, 222	1, 135	1, 172	1, 137	1, 097	14, 794	17, 700
Total Louisiana	1, 808	1, 696	1, 779	1, 746	1, 830	1, 995	2, 016	2, 018	1, 779	1, 747	1, 717	1, 716	21, 847	25, 850
Michigan	31	30	29	37	46	50	56	46	37	73	88	71	594	920
Montana	378	350	358	321	347	309	295	347	336	308	316	350	4, 015	6, 400
New Mexico	78	65	75	71	72	63	88	83	65	88	89	106	943	1, 280
New York	185	181	195	192	211	225	200	230	219	249	251	265	2, 603	8, 750
Ohio:														
Central and eastern	445	441	480	455	492	471	462	473	416	466	418	415	5, 434	11, 950
Northwestern	117	123	138	129	154	149	152	137	122	133	110	117	1, 581	2, 520
Total Ohio	562	564	618	584	646	620	614	610	538	599	528	532	7, 015	14, 470
Oklahoma	21, 040	19, 166	19, 980	18, 921	19, 745	19, 009	19, 175	21, 363	22, 796	23, 862	22, 040	22, 760	249, 857	347, 600
Pennsylvania	768	770	842	792	884	836	838	860	795	893	828	850	9, 956	32, 550
Tennessee	2	4	5	4	5	2	5	8	4	2	3	2	46	70

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[1] Annual and semiannual figures from Division of Mines and Mining, Department of Natural Resources, California. Monthly figures prorated on basis of monthly reports by the American Petroleum Institute.

[2] Salt-dome pools.

[3] Revised figures.

[4] Alaska and Utah.

Petroleum produced in the United States, 1927 and 1928, by States—Continued

[Thousands of barrels of 42 U. S. gallons]

	January	February	March	April	May	June	July	August	September	October	November	December	The year	Value at wells (thousands of dollars)
1928—Continued														
Texas:														
Gulf coast [3]	3,283	2,891	3,248	3,193	3,588	3,259	3,358	3,354	3,199	3,449	3,268	3,448	39,538	47,000
West Texas	8,119	8,272	10,279	11,426	10,735	9,487	11,284	11,210	10,760	10,924	10,245	10,799	123,540	80,520
Rest of State	7,949	7,305	7,803	7,429	7,626	7,549	7,955	8,306	7,929	8,446	7,865	8,080	94,242	108,780
Total Texas	19,351	18,468	21,330	22,048	21,949	20,295	22,597	22,870	21,888	22,819	21,378	22,327	257,320	236,300
West Virginia	460	460	502	451	519	471	481	489	444	506	444	434	5,661	17,150
Wyoming	1,730	1,539	1,873	1,722	1,902	1,833	1,835	1,905	1,808	1,958	1,726	1,630	21,461	27,400
Other [4]				1	1	1	1	1	1				6	30
United States	72,793	68,565	74,528	72,393	75,277	72,676	75,584	77,807	76,484	79,751	76,123	79,493	901,474	1,054,880
Daily average	2,348	2,364	2,404	2,413	2,428	2,423	2,438	2,510	2,549	2,573	2,537	2,564	2,463	
Classified by gravity (approximately):														
Light	64,209	60,365	65,812	64,964	67,691	65,131	67,746	69,959	69,043	71,581	67,901	71,132	805,534	1,054,880
Heavy	8,584	8,200	8,716	7,429	7,586	7,545	7,838	7,848	7,441	8,170	8,222	8,361	95,940	
United States	72,793	68,565	74,528	72,393	75,277	72,676	75,584	77,807	76,484	79,751	76,123	79,493	901,474	1,054,880

[3] Salt-dome pools.

[4] Alaska and Utah.

Daily average production of crude petroleum in the United States, 1927 and 1928, by months and principal States

[Barrels of 42 U. S. gallons]

State	January	February	March	April	May	June	July	August	September	October	November	December	The year
1927													
Arkansas	130, 400	126, 400	123, 400	109, 500	111, 800	110, 400	106, 600	104, 600	102, 700	102, 400	97, 100	91, 100	109, 600
California	651, 400	642, 500	640, 100	650, 000	629, 500	639, 600	625, 400	624, 100	637, 700	629, 600	619, 400	613, 100	633, 400
Kansas	115, 300	119, 400	116, 400	116, 500	115, 700	115, 100	108, 800	108, 300	109, 400	111, 000	109, 200	105, 700	112, 500
Louisiana	61, 600	62, 100	63, 800	63, 300	60, 500	62, 800	65, 500	65, 500	63, 400	62, 100	60, 000	59, 500	62, 500
Oklahoma	599, 900	712, 500	720, 700	713, 600	754, 800	783, 900	864, 800	850, 900	814, 100	796, 900	792, 200	725, 200	761, 000
Texas	569, 400	571, 100	567, 000	583, 200	606, 700	597, 000	572, 000	592, 400	612, 400	614, 900	618, 400	641, 200	595, 600
Wyoming	60, 300	60, 300	60, 200	62, 000	61, 900	59, 100	63, 400	55, 800	53, 200	51, 900	54, 000	58, 300	58, 400
All others	126, 500	138, 600	144, 300	139, 600	138, 000	142, 200	134, 800	139, 900	137, 400	132, 200	132, 800	123, 700	135, 800
	2, 314, 800	2, 432, 900	2, 435, 900	2, 437, 700	2, 478, 900	2, 510, 100	2, 541, 300	2, 541, 500	2, 530, 300	2, 501, 000	2, 483, 100	2, 417, 800	2, 468, 800
1928													
Arkansas	87, 600	88, 600	87, 100	79, 900	91, 200	102, 300	90, 000	86, 500	85, 200	85, 400	86, 700	82, 000	87, 700
California	611, 900	623, 000	615, 500	609, 700	622, 800	639, 800	636, 700	629, 000	630, 200	625, 200	661, 900	694, 200	633, 300
Kansas	108, 500	112, 000	114, 900	114, 100	111, 100	109, 200	105, 900	103, 900	97, 000	99, 100	94, 200	95, 700	105, 400
Louisiana	58, 300	58, 500	57, 400	58, 200	59, 000	66, 500	65, 000	65, 100	59, 300	56, 400	57, 200	55, 400	59, 700
Oklahoma	678, 700	660, 900	644, 500	630, 700	637, 000	633, 600	618, 600	689, 100	759, 900	769, 700	734, 700	734, 200	682, 700
Texas	624, 200	636, 800	688, 100	734, 900	708, 000	676, 500	728, 900	737, 800	729, 600	736, 100	712, 600	720, 200	703, 100
Wyoming	55, 800	53, 000	60, 400	57, 400	61, 400	61, 100	59, 200	61, 500	60, 300	63, 200	57, 500	52, 600	58, 600
All others	123, 200	131, 500	136, 200	128, 200	137, 800	133, 500	133, 900	137, 000	128, 000	137, 500	132, 600	130, 000	132, 500
	2, 348, 200	2, 364, 300	2, 404, 100	2, 413, 100	2, 428, 300	2, 422, 500	2, 438, 200	2, 509, 900	2, 549, 500	2, 572, 600	2, 537, 400	2, 564, 300	2, 463, 000

Arkansas.—Production of crude petroleum in Arkansas continued to decline steadily in 1928; the total output amounted to 32,096,000 barrels, compared with 40,005,000 barrels in 1927. The Champagnolle field, discovered quite late in 1927, was actively developed in 1928 but on the whole never fulfilled expectations. However, production in this field reached a peak of 25,000 barrels daily in May, and the total output for the year—3,522,000 barrels—placed Champagnolle next to Smackover or second in rank among the producing fields of the State.

The discovery at Champagnolle of production at below 3,000 feet, which is comparatively deep for this area, focused attention on deeper drilling but little of importance was opened up. An analysis of the well records for 1928 discloses the interesting fact that the number of dry holes exceeded the number of oil wells brought in.

Petroleum produced in Arkansas, 1921–1928, by districts

[Thousands of barrels of 42 U. S. gallons]

Year	Bradley	Champagnolle	El Dorado	Irma	Lisbon	Smackover	Stephens	Total
1921			10,473					10,473
1922			10,592			2,107	13	12,712
1923			5,830	(1)		30,048	[1] 732	36,610
1924			4,760	450		40,000	818	46,028
1925			4,247	334		72,144	673	77,398
1926	52		2.722	763	2,125	52,063	607	58,332
1927	44	(2)	[2] 2,433	774	1,054	35,201	499	40,005
1928	31	3,522	2,456	536	566	24,569	416	32,096

[1] Irma included with Stephens. [2] Champagnolle included with El Dorado.

Petroleum produced in Arkansas, 1927 and 1928, by districts and months

[Thousands of barrels of 42 U. S. gallons]

District	Petroleum transported from producing properties													Oil consumed on leases plus net change in producers' stocks, Jan. 1-Dec. 31	Production
	January	February	March	April	May	June	July	August	September	October	November	December	The year		
1927															
Bradley	4	5	3	2	3	3	4	3	3	2	3	2	37	7	44
El Dorado [1]	215	195	226	207	217	195	201	201	182	199	189	210	2,437	−4	2,433
Irma	57	52	57	44	42	45	51	57	80	85	99	85	754	20	774
Lisbon	125	108	110	98	94	84	80	79	68	70	62	62	1,040	14	1,054
Smackover	3,607	3,151	3,395	2,902	3,079	2,959	2,937	2,879	2,719	2,794	2,534	2,440	35,396	−195	35,201
Stephens	47	40	48	44	44	40	44	37	42	39	38	38	501	−2	499
	4,055	3,551	3,839	3,297	3,479	3,326	3,317	3,256	3,094	3,189	2,925	2,837	40,165	−160	40,005
1928															
Bradley	3	3	3	1	2	1	3	3	2	3	4	3	31		31
Champagnolle	10	21	12	71	400	763	449	357	369	365	352	351	3,520	2	3,522
El Dorado	199	187	220	210	210	202	215	219	210	210	189	189	2,460	−4	2,456
Irma	89	64	79	32	39	43	42	28	27	30	34	27	534	2	536
Lisbon	57	51	55	49	49	45	45	44	39	38	36	49	557	9	566
Smackover	2,339	2,225	2,310	2,015	2,108	2,000	2,022	2,013	1,895	1,988	1,969	1,910	24,794	−225	24,569
Stephens	37	35	38	36	36	34	33	37	32	32	35	33	418	−2	416
	2,734	2,586	2,717	2,414	2,844	3,088	2,809	2,701	2,574	2,666	2,619	2,562	32,314	−218	32,096

[1] Includes Champagnolle.

California.—The production of crude petroleum in California in 1928 amounted to 231,811,000 barrels, a daily average of 633,400 barrels. Although this total represents a slight increase over 1927 California dropped from second to third among the producing States as the result of the rise of Texas to first place and the fall of Oklahoma to second.

The deeper zones at Long Beach were actively developed in 1928, with the result that the output of the field for the year amounted to 62,467,000 barrels, as compared with 34,542,000 barrels for 1927. This increase was nearly large enough to balance the decrease in output of the older fields which, with but few exceptions, declined in 1928. Considerable deep drilling was also done in the Ventura Avenue field, the results of which were instrumental in increasing the output over that of 1927.

The number of oil wells completed in 1928 declined materially from 1927. Had it not been for the success of deeper drilling at Long Beach, a decline for the State would have been indicated. Another factor that tended to reduce the output in California in 1928 was an increase in the amount of heavy oil shut in, the result of unsatisfactory conditions in the fuel-oil market.

Several important discoveries were made in California in 1928. The most important was the discovery of oil in the north dome at Kettleman Hills, where a large well of high-gravity oil—in fact, nearly pure gasoline—was completed at below 7,000 feet. This discovery was the culmination of years of wildcatting, in which the wells had gone progressively deeper, with increasingly important shows but with a steadily growing number of mechanical difficulties. There are three distinct domes in the Kettleman Hills structure and, whereas the discovery well proved the north dome only, the field because of its great area was at once labeled "the greatest oil field ever discovered."

Another of the most important discoveries of the year was at Elwood, on the coast north of Santa Barbara, where a well of good size was completed in the Vaqueros formation. This formation had been regarded lightly by geologists, and the completion of the discovery well was a signal for a revamping of geological policy and a detailed search for similar structures along the coast between Ventura and San Luis Obispo. It also focused attention on the possibilities of drilling on the beach or under the ocean, as part of the structure at Elwood lies under the Pacific. The next discovery of importance after Elwood was that of the Buckbee deep zone at Santa Fe Springs. This was followed by the opening up of the Nordstrum zone, with still deeper sands in prospect for 1929. The development of these deeper sands was very rapid but, as most of the work was started late in the year, there was no great increase in production in 1928. However, enough new production was brought in during December to cause the field to show an increase over 1927, the first yearly increase since 1923.

The new fields discovered, in addition to Kettleman Hills and Elwood, were Fruitvale, near Bakersfield, and Lawndale, near Los Angeles. The oil found at Fruitvale was of inferior quality, and from this and other reasons the development of the field was not pressed. The same could not be said of Lawndale for, situated near a fairly populous section, it became the center of a hectic drilling campaign on town lots. The net results as the year closed were one or two fair wells and an abundance of dry holes.

Petroleum produced in California, 1924–1928, by counties [1]

[Thousands of barrels of 42 U. S. gallons]

County	1924	1925	1926	1927	1928
Fresno	10, 156	7, 774	7, 340	7, 202	4, 611
Kern	61, 175	58, 853	54, 550	51, 570	44, 097
Kings	-----	-----	(2)	(2)	199
Los Angeles	119, 028	121, 214	105, 826	103, 626	120, 549
Orange	31, 661	32, 734	37, 989	46, 594	37, 101
San Luis Obispo	31	30	28	17	15
Santa Barbara	2, 905	2, 647	1, 925	2, 174	3, 078
Santa Clara	[3] 19	[3] 18	[4] 21	[5] 16	[6] 18
Ventura	3, 958	9, 222	16, 994	19, 997	22, 143
	228, 933	232, 492	224, 673	231, 196	231, 811

[1] Division of Mines and Mining, Department of Natural Resources, California.
[2] Included under Santa Clara.
[3] Includes San Mateo and San Bernardino.
[4] Includes Kings, San Bernardino, San Mateo, and Sonoma.
[5] Includes Colusa, Kings, San Bernardino, San Mateo, and Sonoma.
[6] Includes Colusa and San Mateo.

Petroleum produced in California, 1927 and 1928, by fields

[Barrels of "clean oil," from Division of Mines and Mining, Department of Natural Resources, California]

Field	1927			1928		
	Jan. 1 to June 30	July 1 to Dec. 31	Total	Jan. 1 to June 30	July 1 to Dec. 31	Total
District No. 1:						
Beverly Hills	71, 504	66, 088	137, 592	66, 249	68, 312	134, 561
Brea Olinda	3, 930, 197	3, 138, 127	7, 068, 324	2, 926, 456	2, 861, 797	5, 788, 253
Coyote Hills	2, 635, 661	2, 560, 840	5, 196, 501	2, 476, 011	2, 377, 196	4, 853, 207
Dominguez	3, 181, 346	2, 743, 018	5, 924, 364	2, 322, 576	1, 991, 176	4, 313, 752
Huntington Beach	14, 474, 673	11, 889, 726	26, 364. 399	10, 188, 215	9, 464, 762	19, 652, 977
Inglewood	6, 844, 144	6, 075, 843	12, 919, 987	5, 517, 293	5, 210, 471	10, 727, 764
Lawndale	-----	-----	-----	-----	20, 810	20, 810
Long Beach	16, 691, 199	17, 644, 691	34, 335, 890	26, 854, 650	35, 663, 810	62, 518, 460
Montebello	2, 937, 773	2, 561, 427	5, 499, 200	2, 243, 288	2, 077, 168	4, 320, 456
Newhall	33, 855	34, 411	68, 266	31, 807	31, 854	63, 661
Newport	11, 227	11, 560	22, 787	4, 413	10, 828	15, 241
Potrero	-----	-----	-----	34, 141	73, 243	107, 384
Richfield	3, 820, 861	4, 122, 070	7, 942, 931	3, 582, 054	3, 209, 211	6, 791, 265
Rosecrans	1, 970, 204	1, 531, 666	3, 501, 870	1, 260, 141	1, 133, 482	2, 393, 623
Salt Lake	173, 268	162, 076	335, 344	149, 836	152, 794	302, 630
Santa Fe Springs	7, 897, 094	7, 325, 631	15, 222, 725	6, 826, 619	9, 200, 341	16, 026, 960
Seal Beach	6, 262, 664	10, 238, 107	16, 500, 771	7, 107, 440	5, 311, 436	12, 418, 876
Torrance	4, 437, 919	3, 927, 537	8, 365, 456	3, 406, 022	3, 025, 760	6, 431, 782
Whittier	342, 488	321, 662	664, 150	307, 592	303, 192	610. 784
	75, 716, 077	74, 354, 480	150, 070, 557	75, 304, 803	82, 187, 643	157, 492, 446
Los Angeles City field	[1] 75. 000	[1] 75, 000	150, 000	[1] 81, 850	[1] 80, 000	161, 850
District No. 2:						
Bardsdale	157, 564	149, 577	307, 141	141, 226	137, 544	278, 770
Conejo	804	755	1, 559	300	1, 078	1, 378
Ojai	32, 305	29, 822	62, 127	34, 556	36, 878	71, 434
Piru	77, 105	62, 365	139, 470	68, 912	84, 877	153, 789
Rincon	-----	7, 888	7, 888	342, 913	761, 301	1, 104, 214
Santa Paula	10, 068	13, 315	23, 383	12, 786	11, 191	23, 977
Sespe	30, 698	35, 316	66, 014	30, 327	27, 371	57, 698
Simi	23, 046	23, 652	46, 698	21, 399	21, 155	42, 554
South Mountain	727, 616	748, 309	1, 475, 925	705, 801	699, 428	1, 405, 229
Ventura	8, 621, 363	9, 245, 273	17, 866, 636	9, 279, 095	9, 725, 180	19, 004, 275
	9, 680, 569	10, 316, 272	19, 996, 841	10, 637, 315	11, 506, 003	22, 143, 318

[1] Semiannual figures for Los Angeles City field estimated.

Petroleum produced in California, 1927 and 1928, by fields—Continued

[Barrels of "clean oil," from Division of Mines and Mining, Department of Natural Resources, California]

Field	1927			1928		
	Jan. 1 to June 30	July 1 to Dec. 31	Total	Jan. 1 to June 30	July 1 to Dec. 31	Total
District No. 3:						
Arroyo Grande	8, 747	7, 962	16, 709	7, 230	7, 910	15, 140
Casmalia	14, 636	15, 427	30, 063	12, 503	10, 901	23, 404
Cat Canyon	427, 650	519, 465	947, 115	564, 326	452, 030	1, 016, 356
Elwood					859, 560	859, 560
Goleta	32, 851	61, 342	94, 193	33, 920	9, 704	43, 624
Half Moon Bay [2]	388	388	776			
Lompoc				7, 470	17, 360	24, 830
Moody Gulch		706	706	423		423
Santa Maria	491, 304	571, 191	1, 062, 495	551, 333	513, 219	1, 064, 552
Sargent	5, 855	5, 433	11, 288	6, 611	6, 712	13, 323
Summerland [2]	19, 829	20, 192	40, 021	22, 821	22, 956	45, 777
	1, 001, 260	1, 202, 106	2, 203, 366	1, 206, 637	1, 900, 352	3, 106, 989
District No. 4:						
Belridge-Lost Hills-Devils Den	784, 023	719, 297	1, 503, 320	746, 037	769, 401	1, 515, 438
Elk Hills	5, 332, 365	4, 645, 968	9, 978. 333	4, 342, 803	3, 761, 475	8, 104, 278
Kern County				18, 132	138, 062	156, 194
Kern River	2, 413, 075	3, 435, 416	5, 848, 491	2, 953, 980	1, 940, 117	4, 894, 097
McKittrick-Temblor	955, 816	916, 272	1, 872, 088	896, 480	892, 432	1, 788, 912
Midway-Sunset	16, 426, 858	15, 511, 929	31, 938, 787	13, 773, 178	13, 430, 292	27, 203, 470
Mount Poso	26, 459	15, 544	42, 003	16, 596	36, 448	53. 044
Round Mountain		12, 808	12, 808	36, 332	16, 358	52, 690
Wheeler Ridge	189, 298	185, 284	374, 582	168, 747	159, 768	328, 515
	26, 127, 894	25, 442, 518	51, 570, 412	22, 952, 285	21, 144, 353	44, 096, 638
District No. 5:						
Coalinga	3, 627, 648	3, 574, 637	7, 202, 285	2, 729, 523	1, 881, 917	4, 611, 440
Kings County		1, 510	1, 510	393	198, 391	198, 784
Sonoma County	707	95	802			
	3, 628. 355	3, 576. 242	7, 204, 597	2, 729, 916	2, 080, 308	4, 810, 224
Grand total	[1] 116, 229, 155	[1] 114, 966, 618	231, 195, 773	[1] 112, 912, 806	[1] 118, 898, 659	231, 811, 465

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[1] Semiannual figures for Los Angeles City field estimated.
[2] Estimated.

Petroleum produced in California, 1927 and 1928, by districts and months[1]

[Thousands of barrels of 42 U. S. gallons]

District	January	February	March	April	May	June	July	August	September	October	November	December	The year
1927													
Coalinga	617	556	608	620	622	595	609	596	581	593	576	582	7,155
Coyote	475	415	439	436	443	412	419	410	422	436	410	430	5,147
Dominguez	572	520	566	515	508	477	494	471	457	464	422	422	5,888
Elk Hills	1,064	958	1,037	862	770	750	800	772	780	793	744	743	10,073
Fullerton	782	688	753	678	491	507	553	569	518	525	481	464	7,009
Goleta		1	9	6	5	11	10	11	9	10	8	7	87
Huntington Beach	2,860	2,349	2,408	2,304	2,385	2,195	2,156	2,125	1,940	1,941	1,828	1,854	26,345
Inglewood	1,226	1,072	1,154	1,114	1,111	1,031	1,064	1,042	989	1,012	957	979	12,751
Kern River	410	385	406	418	436	470	501	527	540	610	674	721	6,098
Long Beach	2,870	2,607	2,933	2,801	2,855	2,804	2,868	2,821	2,705	2,906	3,012	3,360	34,542
Los Angeles-Salt Lake	54	51	55	55	54	54	53	54	50	50	51	50	631
Lost Hills-Belridge	149	132	151	127	119	114	114	122	120	123	115	129	1,515
McKittrick	164	144	160	158	157	156	155	157	149	153	150	153	1,856
Midway-Sunset	2,805	2,508	2,748	2,765	2,795	2,690	2,675	2,635	2,541	2,561	2,441	2,507	31,671
Montebello	542	464	506	484	476	456	448	438	437	440	406	401	5,498
Mount Poso	7	6	5	4	2	2	1	1	2	3	4	3	40
Richfield	631	592	637	644	657	660	706	687	663	664	673	670	7,884
Rincon											1	5	6
Rosecrans	371	329	337	350	316	280	272	264	238	241	244	264	3,506
Santa Fe Springs	1,385	1,243	1,344	1,299	1,331	1,260	1,281	1,233	1,198	1,213	1,163	1,203	15,153
Santa Maria	144	139	152	152	154	167	178	181	171	182	197	182	1,999
Seal Beach	313	444	806	1,140	1,531	1,990	1,791	1,786	1,914	1,892	1,500	1,318	16,425
Summerland	4	4	4	5	4	4	4	4	4	4	4	4	49
Torrance	799	702	752	727	739	700	707	683	642	642	615	631	8,339
Ventura Avenue	1,673	1,421	1,582	1,552	1,258	1,125	1,183	1,421	1,725	1,712	1,572	1,585	17,809
Ventura-Newhall	171	170	186	187	188	179	190	184	182	193	183	185	2,198
Wheeler Ridge	33	29	35	31	32	31	31	32	33	28	29	31	375
Whittier	61	51	60	56	63	53	53	51	52	54	52	54	660
Other	3	3	3	4	4	8	3	2	2	4	4	2	42
	20,185	17,983	19,836	19,494	19,506	19,181	19,319	19,279	19,064	19,449	18,516	18,939	230,751
Division of Mines and Mining, Department of Natural Resources, California[2]	20,192	17,990	19,844	19,501	19,514	19,188	19,386	19,347	19,131	19,517	18,581	19,005	231,196
1928													
Coalinga	607	567	602	324	325	319	326	329	314	326	305	311	4,655
Coyote	433	401	424	407	422	403	417	419	389	406	392	389	4,902
Dominguez	402	368	390	380	388	366	359	342	320	320	310	322	4,267
Elk Hills	746	707	729	709	724	707	670	669	632	631	587	596	8,107
Elwood-Goleta	9	9	6	5	3	2	13	72	76	76	252	372	895
Fruitvale							11	9	10	30	32	41	133

Fullerton	465	496	485	484	507	471	457	453	512	487	471	455	5,743
Huntington Beach	1,817	1,681	1,756	1,632	1,677	1,603	1,640	1,605	1,567	1,591	1,538	1,535	19,642
Inglewood	968	890	933	893	911	906	929	931	851	868	833	850	10,763
Kern River	777	788	801	293	213	200	190	188	175	345	544	557	5,071
Kettleman Hills										5	79	116	200
Long Beach	3,506	3,436	3,877	4,611	5,619	5,831	6,078	5,918	5,940	5,987	5,870	5,794	62,467
Los Angeles-Salt Lake	47	47	48	48	46	47	48	46	45	48	46	45	561
Lost Hills-Belridge	129	128	127	122	126	124	133	126	121	126	130	135	1,527
McKittrick	148	141	153	151	157	147	150	159	148	151	146	155	1,806
Midway-Sunset	2,471	2,338	2,506	2,193	2,189	2,125	2,228	2,287	2,186	2,277	2,247	2,267	27,314
Montebello	396	378	386	375	376	364	368	370	346	344	326	341	4,370
Mount Poso	3	3	1	1	1	4	12	8	9	5	2	5	54
Potrero				2	17	15	13	12	10	9	8	21	107
Richfield	655	579	600	584	587	573	573	555	511	528	514	540	6,799
Rincon	14	12	32	58	90	122	111	111	124	148	135	126	1,083
Rosecrans	245	217	209	197	194	197	190	181	183	183	180	216	2,392
Santa Fe Springs	1,200	1,099	1,165	1,107	1,145	1,116	1,137	1,227	1,121	1,115	1,641	3,021	16,094
Santa Maria	191	189	200	186	178	163	162	154	150	159	157	153	2,042
Seal Beach	1,288	1,188	1,243	1,166	1,121	1,105	1,047	898	787	836	875	882	12,436
Summerland	4	3	4	4	4	4	4	4	3	4	3	4	45
Torrance	611	567	590	562	550	527	561	535	496	502	471	482	6,454
Ventura Avenue	1,617	1,547	1,588	1,534	1,495	1,459	1,663	1,574	1,629	1,682	1,561	1,572	18,921
Ventura-Newhall	195	176	176	171	179	168	179	177	171	156	173	175	2,096
Wheeler Ridge	29	28	28	26	30	28	29	28	27	27	25	25	330
Whittier	52	50	53	51	52	52	51	49	49	53	49	51	612
Other	3	5	6	5	6	16	6	9	6	6	6	21	95
	19,028	18,038	19,118	18,281	19,332	19,164	19,755	19,445	18,908	19,431	19,908	21,575	231,983
Division of Mines and Mining, Department of Natural Resources, California [2]	18,969	18,066	19,082	18,292	19,308	19,195	19,737	19,499	18,905	19,381	19,856	21,521	231,811

[1] Monthly figures by districts from American Petroleum Institute.

[2] Monthly figures prorated from annual and semiannual totals.

Colorado.—In spite of material increases in output in the Florence and Iles Dome fields in 1928 the output of crude petroleum in Colorado decreased. The total quantity produced in 1928 amounted to 2,774,000 barrels, as compared with 2,831,000 barrels in 1927. Few wells were completed on the Fort Collins and Moffat structures, and the output of each of these districts declined. Wildcatting in 1928 resulted in the discovery of several new gas fields and one oil field—the South McCallum, in Jackson County.

Petroleum produced in Colorado, 1919–1928, by districts

[Thousands of barrels of 42 U. S. gallons]

Year	Boulder	Florence	Fort Collins	Iles Dome	Moffat	Rangely	Tow Creek	Total
1919	5	102				14		121
1920	7	88				16		111
1921	5	83				20		108
1922	4	70				23		97
1923	4	62				20		86
1924	4	70	86		256	29		445
1925	3	97	430	17	605	32	42	1, 226
1926	2	148	1, 222	24	1, 199	33	140	2, 768
1927	(1)	[2] 291	1, 260	263	670	[3] 69	278	2, 831
1928	(1)	[2] 430	1, 030	626	464	[3] 34	190	2, 774

[1] Included with Rangely. [2] Includes Canon City. [3] Includes Boulder and Walden.

Petroleum produced in Colorado, 1927 and 1928, by districts and months

[Thousands of barrels of 42 U. S. gallons]

District	Petroleum transported from producing properties													Oil consumed on leases plus net change in producers' stocks, Jan. 1–Dec. 31	Production
	January	February	March	April	May	June	July	August	September	October	November	December	The year		
1927															
Boulder Rangely [1]	3	5	10	8	5	4	5	5	4	5	2	1	57	12	69
Florence [2]	10	15	20	24	26	28	31	31	27	28	25	26	291		291
Fort Collins	126	112	119	113	109	98	109	101	93	93	91	98	1, 262	−2	1, 260
Iles Dome	1	1	2	46	15	15	16	15	16	34	46	47	254	9	263
Moffat	82	71	70	61	58	45	52	48	47	43	40	32	649	21	670
Tow Creek	11	17	23	48	30	27	28	29	21	15	15	13	277	1	278
	233	221	244	300	243	217	241	229	208	218	219	217	2, 790	41	2, 831
1928															
Boulder Rangely [1]	2	1	2	3	3	2	2	3	3	4	2	3	30	4	34
Florence [2]	28	34	37	39	41	34	38	32	34	36	39	38	430		430
Fort Collins	101	96	109	94	91	80	83	80	75	76	73	72	1, 030		1, 030
Iles Dome	37	52	51	27	31	57	67	69	48	57	52	53	601	25	626
Moffat	37	33	48	44	38	34	35	39	33	39	35	27	442	22	464
Tow Creek	15	13	13	13	18	18	22	17	15	15	16	15	190		190
	220	229	260	220	222	225	247	240	208	227	217	208	2, 723	51	2, 774

[1] Includes Walden. [2] Includes Canon City.

Kansas.—The number of oil wells completed in Kansas during 1928 was smaller than in any year since 1924, and the total output of the State declined from 41,069,000 barrels in 1927 to 38,596,000 barrels in 1928.

The most important event of the year was the discovery of the Wright pool in Sedgwick County, 6 miles north of Wichita. The discovery well of this field had a comparatively high initial yield and, much to the surprise of many, showed a well-sustained production. This strike did much to stimulate interest in southeast Kansas, and the immediate vicinity of Wichita became the center of a feverish leasing campaign. Other important discoveries occurred in various western counties, where numerous oil shows were found and where nearly all of the major companies acquired large blocks of leases. The Lost Springs field in Marion County, which appeared very promising after its discovery in 1927, was a disappointment. In Ellis County a good producer was brought in, which served to maintain the interest shown in the possibilities of western Kansas.

Petroleum produced in Kansas, 1927 and 1928, by districts and months [1]

[Thousands of barrels of 42 U. S. gallons]

District	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	The year
1927													
Anderson	90	78	82	68	74	69	70	58	57	59	63	64	832
Butler:													
Eldorado	218	194	241	238	244	234	239	242	225	238	220	226	2,759
Leon-Weaver	70	65	74	39	100	72	109	117	109	108	102	105	1,070
Other	611	539	600	620	597	569	563	557	517	522	492	502	6,689
Cowley:													
Rainbow	89	70	73	63	71	64	67	65	62	62	58	59	803
Winfield-New Salem	85	72	86	122	113	107	101	114	110	106	95	96	1,207
Other	123	107	118	105	110	104	111	108	105	105	98	100	1,294
Greenwood-Woodson:													
Seely	419	377	384	351	355	330	318	302	295	291	262	253	3,937
Teeter-Pixley	434	371	390	357	342	318	326	318	289	287	266	260	3,958
Virgil	137	123	134	132	131	126	140	163	168	175	191	201	1,821
Other	313	278	290	258	254	242	237	239	216	220	201	199	2,947
Russell	109	95	97	88	94	87	86	79	75	81	67	68	1,026
Sumner	499	458	519	527	592	551	517	479	527	665	634	740	6,708
Woodson	21	19	20	19	20	19	23	36	35	36	32	32	312
Other	552	506	567	530	607	546	547	565	552	554	533	522	6,581
	3,770	3,352	3,675	3,517	3,704	3.438	3,454	3,442	3,342	3,509	3,314	3,427	41,944
Bureau of Mines [2]	3,575	3,342	3,608	3,496	3,586	3,452	3,374	3,357	3,283	3,441	3,277	3,278	41,069
1928													
Anderson	61	55	57	55	58	55	59	53	51	53	51	53	661
Butler:													
Eldorado	222	203	230	215	223	215	214	228	217	223	215	215	2,620
Leon-Weaver	102	98	106	113	113	108	114	183	209	225	218	202	1,791
Other	486	444	476	444	450	430	434	444	418	429	414	410	5,279
Cowley:													
Rainbow	49	44	47	44	43	41	40	36	34	33	30	31	472
Winfield-New Salem	88	72	80	70	71	69	66	64	58	57	54	55	804
Other	96	88	94	89	93	86	86	80	75	75	72	74	1,008
Greenwood-Woodson:													
Seely	245	224	233	222	223	216	222	203	187	192	186	177	2,530
Teeter-Pixley	233	217	226	208	209	201	200	199	184	182	175	178	2,412
Virgil	216	219	246	258	250	240	241	224	234	225	216	212	2,781
Other	198	181	194	192	194	185	186	178	168	165	147	161	2,149
Russell	72	81	93	91	111	105	128	138	122	127	124	112	1,304
Sedgwick	------	------	------	------	------	------	------	------	50	46	112	171	379
Sumner	695	661	736	874	779	732	663	600	565	536	494	453	7,788
Woodson	32	28	33	32	31	30	30	30	12	25	24	29	336
Other	524	465	528	505	520	489	489	487	463	466	446	455	5,837
	3,319	3,080	3,379	3,412	3,368	3,202	3,172	3,147	3,047	3,059	2,978	2,988	38,151
Bureau of Mines [2]	3,362	3,248	3,561	3,422	3,444	3,274	3,283	3,222	2,912	3,073	2,828	2,967	38,596

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[1] Monthly estimates by districts from Oil and Gas Journal.

[2] Separation by fields not available.

Louisiana.—The production record for Louisiana in 1928 was very similar to that in 1927 in that the increase in output of the Gulf coast fields was more than offset by the decrease in the northern fields, the net result being a small decline for the State as a whole.

With the exception of the Red River-Bull Bayou-Crichton field, which recorded a slight increase in output, the production in all the northern fields declined in 1928. A number of the more recently discovered Gulf coast fields, particularly Hackberry and Sulphur, recorded material gains in output in 1928 and bade fair to become important factors in the future production of the State.

Development work centered around the drilling of deep tests for oil in many of the northern fields and in the completion of gas wells to care for the rapidly increasing demand for natural gas. The Trinity sand of the Cotton Valley field was thoroughly tested; but the wells completed failed by far to measure up to the discovery well, and, except for the gas uncovered, the results were disappointing.

Petroleum produced in Louisiana, 1919–1928, by districts

[Thousands of barrels of 42 U. S. gallons]

Year	Gulf coast (salt-dome pools)												
	Anse la Butte	Bayou Bouillon	Edgerley	Hackberry	Jennings	Lockport	Sorrento	Starks	Sulphur	Sweet Lake	Vinton	Other	Total
1919	-------	-------	361	-------	347	-------	-------	-------	-------	-------	1,592	9	2,309
1920	-------	-------	379	-------	232	-------	-------	-------	-------	-------	1,333	3	1,947
1921	47	-------	250	-------	254	-------	-------	-------	-------	-------	1,379	-------	1,930
1922	36	-------	125	-------	191	-------	-------	-------	-------	-------	1,395	-------	1,747
1923	18	-------	157	-------	204	-------	-------	-------	-------	-------	2,071	-------	2,450
1924	12	-------	166	-------	213	128	-------	-------	-------	-------	1,968	-------	2,487
1925	17	-------	185	-------	278	471	-------	-------	-------	-------	2,274	[1] 2	3,227
1926	17	-------	207	-------	342	1,343	-------	-------	-------	(2)	2,215	[3] 16	4,140
1927	17	-------	467	42	299	2,038	-------	262	(2)	77	1,786	[4] 62	5,050
1928	16	205	358	1,149	250	1,445	289	186	890	661	1,569	[5] 35	7,053

Year	Northern											Total for State
	Bellevue	Caddo	Cotton Valley	De Soto	Elm Grove	Haynesville	Homer	Red River (Bull Bayou, Crichton)	Urania	Other	Total	
1919	-------	[6] 8,700	-------	[6] 1,200	-------	-------	[6] 2,000	[6] 2,900	-------	79	14,879	17,188
1920	-------	6,336	-------	(7)	-------	-------	21,508	[7] 5,923	-------	-------	33,767	35,714
1921	-------	5,342	-------	719	-------	3,161	13,030	2,844	-------	77	25,173	27,103
1922	1,050	4,498	-------	531	160	19,939	5,673	1,778	-------	-------	33,629	35,376
1923	2,351	4,178	-------	429	220	10,496	3,581	1,207	-------	7	22,469	24,919
1924	1,749	4,319	1,211	353	217	6,720	2,837	1,231	-------	-------	18,637	21,124
1925	1,129	4,067	3,348	305	212	4,604	2,296	1,074	10	-------	17,045	20,272
1926	788	4,749	2,914	321	222	3,328	2,033	1,037	3,669	-------	19,061	23,201
1927	472	5,789	1,968	541	222	2,600	1,785	1,070	3,321	-------	17,768	22,818
1928	323	4,798	1,731	463	185	2,150	1,548	1,109	2,487	-------	14,794	21,847

[1] Welsh.
Included under "Other."
Sweet Lake and Welsh.
Iberia, Sulphur, and Welsh.
[5] Iberia and Welsh.
[6] Estimated.
[7] De Soto included with Red River.

Petroleum produced in Louisiana, 1927 and 1928, by districts and months

[Thousands of barrels of 42 U. S. gallons]

District	Petroleum transported from producing properties													Oil consumed on leases plus net change in producers' stocks, Jan. 1-Dec. 31	Production
	January	February	March	April	May	June	July	August	September	October	November	December	The year		
1927															
Gulf coast (salt-dome pools):															
Anse la Butte [1]	5	12	9	14	13	14	3	1	1	1	2	45	120	78	198
Edgerley	16	21	18	15	45	30	29	73	61	51	47	57	463	4	467
Jennings	26	19	21	17	20	21	30	25	25	26	22	23	275	24	299
Lockport	99	79	175	222	212	217	194	167	162	186	163	162	2,038	------	2,038
Starks	-----	7	55	45	30	24	19	13	22	14	7	8	244	18	262
Vinton	165	142	158	153	122	140	171	143	132	142	167	140	1,775	11	1,786
	311	280	436	466	442	446	446	422	403	420	408	435	4,915	135	5,050
Northern:															
Bellevue	47	47	49	42	38	41	37	35	37	32	34	31	470	2	472
Caddo	434	406	453	402	448	461	576	581	520	516	497	506	5,800	−11	5,789
Cotton Valley	191	163	176	171	178	165	164	167	155	155	142	140	1,967	1	1,968
De Soto	27	33	34	42	40	45	60	56	59	54	46	46	542	−1	541
Elm Grove	20	19	18	18	19	18	18	19	18	18	16	17	218	4	222
Haynesville	239	214	240	226	237	222	220	218	209	213	197	194	2,629	−29	2,600
Homer	162	146	160	156	156	151	147	147	139	144	139	139	1,786	−1	1,785
Red River (Bull Bayou, Crichton)	94	81	90	84	80	88	89	89	87	97	101	95	1,075	−5	1,070
Urania	376	341	314	285	229	237	265	288	266	269	213	231	3,314	7	3,321
	1,590	1,450	1,534	1,426	1,425	1,428	1,576	1,600	1,490	1,498	1,385	1,399	17,801	−33	17,768
	1,901	1,730	1,970	1,892	1,867	1,874	2,022	2,022	1,893	1,918	1,793	1,834	22,716	102	22,818
1928															
Gulf coast (salt-dome pools):															
Anse la Butte [2]	2	1	1	2	4	4	5	5	1	2	2	3	32	19	51
Bayou Bouillon	-----	-----	34	19	14	19	18	19	30	21	19	12	205	------	205
Edgerley	50	48	32	27	25	29	32	27	23	21	20	24	358	------	358
Hackberry	28	33	54	46	95	126	144	130	81	83	130	158	1,108	41	1,149
Jennings	20	20	24	21	15	19	18	22	21	18	21	21	240	10	250
Lockport	152	133	126	133	123	118	111	107	105	104	110	123	1,445	------	1,445
Sorrento	-----	22	17	2	1	54	52	35	29	21	17	37	287	2	289
Starks	7	6	4	5	4	3	17	21	28	22	23	25	165	21	186
Sulphur	-----	-----	-----	37	51	147	134	156	89	76	53	48	791	99	890
Sweet Lake	19	22	21	-----	-----	103	114	123	94	64	46	28	634	27	661
Vinton	137	128	145	129	136	134	133	131	125	123	121	121	1,563	6	1,569
	415	413	458	421	468	756	778	776	626	555	562	600	6,828	225	7,053
Northern:															
Bellevue	30	29	36	30	28	24	21	23	23	25	31	23	323	------	323
Caddo	498	432	412	366	421	376	394	397	368	380	392	360	4,796	2	4,798
Cotton Valley	139	132	135	244	189	147	145	135	123	128	114	103	1,734	−3	1,731
De Soto	45	40	42	37	38	36	36	40	36	39	36	36	461	2	463
Elm Grove	17	15	15	16	18	15	15	15	14	14	14	14	182	3	185
Haynesville	191	180	195	184	193	182	179	180	168	174	165	162	2,153	−3	2,150
Homer	132	126	140	131	134	129	129	129	123	127	121	127	1,548	------	1,548
Red River (Bull Bayou, Crichton)	94	88	96	93	95	94	94	94	90	93	87	91	1,109	------	1,109
Urania	227	223	231	205	226	218	206	209	189	192	176	180	2,482	5	2,487
	1,373	1,265	1,302	1,306	1,342	1,221	1,219	1,222	1,134	1,172	1,136	1,096	14,788	6	14,794
	1,788	1,678	1,760	1,727	1,810	1,977	1,997	1,998	1,760	1,727	1,698	1,696	21,616	231	21,847

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[1] Includes Hackberry, Iberia, Sulphur, Sweet Lake, and Welsh.

[2] Includes Iberia and Welsh.

Montana.—The production of crude petroleum in Montana continued to decline and in 1928 amounted to 4,015,000 barrels, as compared with 5,058,000 in 1927. Virtually all of this decrease was recorded in the Kevin-Sunburst field, which produced 79 per cent of the total for the State in 1928; the output of Cat Creek, which ranked second in production, also declined. The Pondera field, discovered in 1927, became a factor in production in the summer of 1928, but Bannatyne, also discovered in 1927, was a disappointment. The decline in production and the distinct lack of success in wildcatting caused a shortage of crude, and many of the small skimming plants near Sunburst were forced to shut down.

Petroleum produced in Montana, 1919–1928, by districts

[Thousands of barrels of 42 U. S. gallons]

Year	Cat Creek	Elk Basin	Kevin-Sunburst	Lake Basin	Pondera	Other	Total
1919	----------	90	----------	----------	----------	----------	90
1920	243	97	----------	----------	----------	----------	340
1921	1,408	75	----------	----------	----------	26	1,509
1922	2,333	46	36	----------	----------	34	2,449
1923	2,227	28	523	----------	----------	4	2,782
1924	1,572	24	1,217	----------	----------	2	2,815
1925	1,255	21	2,780	31	----------	4	4,091
1926	1,015	19	6,630	63	----------	----------	7,727
1927	[1] 779	17	4,214	48	----------	----------	5,058
1928	[1] 613	20	3,189	43	150	----------	4,015

[1] Includes small amounts from Bannatyne and Devils Basin.

Petroleum produced in Montana, 1927 and 1928, by districts and months

[Thousands of barrels of 42 U. S. gallons]

District	Petroleum transported from producing properties													Oil consumed on leases plus net change in producers' stocks, Jan. 1-Dec. 31	Production
	January	February	March	April	May	June	July	August	September	October	November	December	The year		
1927															
Cat Creek [1]	73	64	73	71	70	65	65	66	60	59	56	54	776	3	779
Elk Basin	1	1	2	1	2	1	2	1	2	2	1	1	17	------	17
Kevin-Sunburst	330	327	367	335	380	405	395	376	350	340	300	283	4,188	26	4,214
Lake Basin	4	5	4	4	2	3	4	12	3	3	4	2	50	−2	48
	408	397	446	411	454	474	466	455	415	404	361	340	5,031	27	5,058
1928															
Cat Creek [1]	54	51	55	52	53	52	50	50	51	46	45	46	605	8	613
Elk Basin	1	1	2	1	1	1	1	2	2	2	2	2	18	2	20
Kevin-Sunburst	320	295	297	265	289	254	241	277	263	227	227	238	3,193	−4	3,189
Lake Basin	2	3	3	3	3	2	2	9	4	5	5	5	46	−3	43
Pondera	-----	-----	-----	-----	-----	-----	-----	9	15	28	36	59	147	3	150
	377	350	357	321	346	309	294	347	335	308	315	350	4,009	6	4,015

[1] Includes small amounts from Bannatyne and Devils Basin.

New Mexico.—Although the production of crude petroleum in New Mexico in 1928 amounted to only 943,000 barrels, a material decrease from 1927, the importance of the State as a potential producer was probably greatly increased. This apparent paradox resulted from the importance placed upon wildcatting in the southeast corner of the State in the attempt to find extensions to the west Texas discoveries; although no large producing fields were uncovered in 1928 a number of important gassers were completed, indicating the presence of a large gas reserve and disclosing important geological information not obtainable heretofore through lack of information on surface geology. The output of all the producing fields of the State, with the exception of Maljamar, declined in 1928, although the decrease in the the light-oil fields of San Juan County could have been averted had there been a sufficient market for the oil.

Petroleum produced in New Mexico, 1925–1928, by districts

[Thousands of barrels of 42 U. S. gallons]

Year	Artesia	Hogback	Maljamar	Rattlesnake [1]	Total
1925	748	187		125	1,060
1926	1,016	221	2	427	1,666
1927	582	223	39	382	1,226
1928	410	169	69	295	943

[1] Includes Bloomfield in 1925; Bloomfield and Table Mesa in 1926; and Bloomfield, Hospah, and Table Mesa in 1927 and 1928.

Petroleum produced in New Mexico, 1927 and 1928, by districts and months

[Thousands of barrels of 42 U. S. gallons]

District	Petroleum transported from producing properties													Oil consumed on leases plus net change in producers' stocks, Jan. 1–Dec. 31	Production
	January	February	March	April	May	June	July	August	September	October	November	December	The year		
1927															
Artesia	62	55	54	53	52	46	46	43	43	39	43	39	575	7	582
Hogback	23	24	25	23	21	23	13	13	15	8	19	20	227	−4	223
Maljamar			7	3	4	5	4	3	3	3	3	4	39		39
Rattlesnake [1]	46	57	55	67	23	16	22	22	11	14	11	17	361	21	382
	131	136	141	146	100	90	85	81	72	64	76	80	1,202	24	1,226
1928															
Artesia	40	34	38	37	37	34	33	33	29	33	30	30	408	2	410
Hogback	21	14	17	15	12	6	8	14	15	15	16	16	169		169
Maljamar	7	5	6	6	6	6	6	6	5	6	5	5	69		69
Rattlesnake [1]	11	13	15	14	18	18	42	31	17	35	39	56	309	−14	295
	79	66	76	72	73	64	89	81	66	89	90	107	955	−12	943

[1] Includes Bloomfield, Hospah, and Table Mesa.

Oklahoma.—Production in Oklahoma in 1928 amounted to 249,857,000 barrels, a decrease of 27,918,000 barrels from the peak production of 1927. The output of the Seminole district held up much better than was commonly thought possible and with the help of a few new productive areas declined only about 10,000,000 barrels from its 1927 record. The total production of the Seminole district, including the St. Louis-Pearson-Maud area, amounted to nearly 127,000,000 barrels in 1928, or about 50 per cent of the total for the State.

The year 1928 was a disappointing one for the operators in the old fields, as they suffered a decline in their output with no improvement in prices. The output in nearly all of the older fields of the State fell off in 1928, and the year was singularly free from extensions and deeper discoveries in these areas.

The most important discovery of the year was made near Oklahoma City, where a well was completed on a large structure at a depth of about 6,400 feet for nearly 6,000 barrels initial. Although there was considerable disagreement as to the producing formation in this well and its potentialities there was no doubt that this discovery had first importance, as it opened up for development a large area previously considered unpromising. Another important discovery was the establishment of production from the Wilcox sand in the Allen area, which, like the Oklahoma City well described above, caused considerable revamping of geological maps. From the standpoint of new production the discovery of the Mission, Maud, and St. Louis pools had the greatest importance. The St. Louis field proved to be directly on top of a rich spot in the Wilcox sand and, although very small in area, reached a peak of 140,000 barrels a day late in the year.

Wildcatting in Oklahoma declined materially in 1928 and reached the lowest level in years. The abundance of crude and the low price combined to discourage the wildcatter, particularly individual operators who have done the greater part of the wildcatting in the past. Conditions were particularly severe on promoters with acreage to lease, and many of them turned to royalties as a more promising source of income.

The year was important from the standpoint of conservation; and, while many of the proposed agreements to curtail output in flush areas were never fulfilled, material benefit resulted from the shutting down of discovery wells in a number of new areas.

Petroleum produced in Oklahoma, 1927 and 1928, by districts and months [1]

[Thousands of barrels of 42 U. S. gallons]

District	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	The year
1927													
Allen	15	14	16	20	20	19	51	71	91	139	220	227	903
Braman:													
North	536	284	325	293	199	118	92	98	84	86	55	60	2, 230
South	148	120	262	144	96	108	85	80	74	67	101	70	1, 355
Bristow-Kelleyville and Depew	741	648	698	659	676	655	596	627	590	610	537	549	7, 586
Burbank	1, 408	1, 298	1, 476	1, 369	1, 423	1, 350	1, 280	1, 237	1, 113	1, 081	1, 071	1, 160	15, 266
Cromwell	431	379	432	411	399	389	388	376	307	351	329	329	4, 521
Cushing-Shamrock	647	554	611	583	594	578	574	583	591	557	522	548	6, 942
Davenport	131	111	122	113	110	98	100	96	90	90	83	81	1, 225
Duncan	155	147	166	197	178	170	157	170	155	161	171	175	2, 002
Fox-Graham	322	286	301	288	289	270	284	273	261	267	226	240	3, 307
Garber	667	547	584	529	488	424	368	364	334	347	326	315	5, 293
Glenn-Sapulpa and Kiefer	268	226	260	240	247	239	244	245	237	239	231	227	2, 903
Grady County	126	173	192	249	286	270	283	269	260	222	214	220	2, 764
Healdton	461	418	467	454	469	448	467	471	447	460	433	453	5, 448
Hewitt	318	278	311	305	309	288	305	295	280	294	277	279	3, 539
Lovell-Marshall	------	------	------	------	------	------	74	73	76	73	70	70	436
Osage (outside Burbank)	1, 016	906	965	959	964	944	933	927	892	885	874	878	11, 143
Papoose-Gilcrease	247	218	224	222	224	205	199	200	190	186	179	174	2, 468
Pearson	------	------	------	------	------	------	153	123	133	121	129	154	813
Seminole	5, 776	8, 264	9, 684	10, 077	10, 809	10, 995	14, 720	14, 596	13, 170	13, 417	12, 754	11, 689	135, 951
Sholem-Alechem	394	376	450	486	512	509	474	512	400	388	374	381	5, 256
Tonkawa	898	748	805	668	692	645	621	646	568	521	459	476	7, 747
Wewoka	683	463	527	529	612	575	579	486	428	408	320	290	5, 900
Other	3, 648	3, 294	3, 603	3, 413	3, 663	3. 533	3, 496	3, 465	3, 341	3, 277	3, 128	3, 163	41, 024
	19, 036	19, 752	22, 481	22, 208	23, 259	22, 830	26, 523	26, 283	24, 112	24, 247	23, 083	22, 208	276, 022
Bureau of Mines [2]	18, 596	19, 951	22, 341	21, 407	23, 400	23, 516	26, 810	26, 377	24, 424	24, 704	23, 767	22, 482	277, 775
1928													
Allen	286	304	324	427	640	638	661	646	675	726	751	881	6, 959
Braman:													
North	93	89	88	90	89	87	93	90	84	85	76	78	1, 042
South	59	55	59	52	48	46	47	46	38	44	37	38	569
Bristow-Kelleyville and Depew	558	515	490	460	462	445	463	462	441	454	433	442	5, 625
Burbank	1, 146	1, 152	1, 324	1, 215	1, 137	966	936	915	876	816	805	772	12, 060
Cromwell	314	293	315	294	300	288	289	288	236	271	247	252	3, 387
Cushing-Shamrock	547	521	530	523	533	517	546	576	559	548	569	552	6, 521
Davenport	79	70	72	65	69	60	59	63	59	58	56	54	764
Duncan	169	149	187	193	197	189	187	211	217	222	167	177	2, 265
Eastern Bristow	183	171	174	213	234	223	231	229	232	262	246	249	2, 647
Fox-Graham	241	222	235	226	224	216	217	213	195	197	188	190	2, 564
Garber	284	268	251	262	270	256	258	239	255	197	204	199	2, 943
Glenn-Sapulpa and Kiefer	209	187	200	192	196	189	193	188	180	189	183	183	2, 289
Grady County	168	189	194	180	175	168	193	191	189	196	154	165	2, 162
Healdton	441	402	429	416	438	419	439	423	417	426	406	413	5, 069
Hewitt	276	255	272	281	293	283	292	297	269	276	269	275	3, 338
Lovell-Marshall	65	116	197	190	179	173	196	316	283	291	270	417	2, 693
Osage (outside Burbank)	812	800	826	846	818	918	819	806	799	728	747	747	9, 666
Papoose-Gilcrease	159	116	149	137	137	129	127	127	121	124	108	112	1, 546
St. Louis-Pearson	259	334	450	453	496	681	1, 224	2, 047	3, 333	3, 910	3, 890	4, 158	21, 235
Seminole	10, 421	9, 157	9, 255	8, 345	8, 429	7, 721	7, 459	8, 694	9, 362	9, 733	8, 756	8, 396	105, 728
Sholem-Alechem	403	379	414	494	505	480	474	473	433	441	436	450	5, 382
Tonkawa	476	428	456	425	432	414	416	392	373	372	347	347	4, 878
Wewoka	260	263	240	225	214	195	190	177	164	167	161	159	2, 415
Other	3, 070	2, 859	3, 032	2, 893	2, 928	2, 782	2, 800	2, 732	2, 667	2, 698	2, 573	2, 720	33, 754
	20, 978	19, 294	20, 163	19, 097	19, 443	18, 483	18, 809	20, 841	22, 457	23, 431	22, 079	22, 426	247, 501
Bureau of Mines [2]	21, 040	19, 166	19, 980	18, 921	19, 745	19, 009	19, 175	21, 363	22, 796	23, 862	22, 040	22, 760	249 857

[1] Monthly estimates by districts from Oil and Gas Journal. [2] Separation by fields not available.

Texas.—The production of crude petroleum in Texas in 1928 amounted to 257,320,000 barrels, an increase of approximately 40,000,000 barrels over 1927. This substantial output and the declining output of Oklahoma combined to raise Texas for the first time to the position of leading producing State. The nearest previous approaches to first rank occurred in 1902, when the output of Texas was second only to that of Ohio, and in 1904 and 1905, when it was second to that of California.

In Texas the producing fields are widely scattered and differ greatly in character. For the purpose of this discussion they are classified as follows: North central Texas, east and south central Texas, Panhandle, west Texas, southwest Texas, and the Gulf coast or salt-dome districts.

Drilling activity in the north Texas area was as active in 1928 as in 1927, but the average initial production of the completions was smaller and the total output declined from 54,806,000 barrels in 1927 to 49,459,000 barrels in 1928. The major portion of the flush production in 1928 came from the Greyback pool of Wilbarger County, where light-oil wells with a daily initial of several thousand barrels were completed. Wildcatting was active, particularly in Coleman and Young Counties, but the discoveries were almost without exception small in size and the output not well sustained.

The production of crude petroleum in east and south central Texas, or the Balcones fault fields, amounted to 16,221,000 barrels in 1928, the fourth successive year in which these fields have declined in output. The decrease in 1928, however, was less than that in 1927. The most important event of the year in this area was the discovery of the Bruner field near the town of Luling. This field was opened inauspiciously with small wells in the Austin chalk but, upon the completion of sizable wells in the Edwards lime later in the year, became at once the most important field in the area. The older fields of the district were quiet, with few inside completions and only sporadic attempts at extensions. The majority of the promising spots uncovered are near Luling in the same serpentine formation that supplied the production at Lytton Springs.

Natural-gas developments in the Panhandle in 1928 overshadowed petroleum operations, and the output fell from 40,253,000 barrels in 1927 to 25,286,000 barrels in 1928, or to about the 1926 level. As might have been expected, the major portion of the decrease in 1928 occurred in Hutchinson County, the leading producing county of the district. The chief activity as regards new production centered in Moore and Gray Counties, particularly the latter, where a number of large wells were brought in. These wells were thought to be the forerunners of major pools, but later completions were usually considerably smaller and attended by large quantities of edge water. Wildcatting in the Panhandle, except in fairly close proximity to proven acreage, fell off almost to the vanishing point.

The total production of the various west Texas fields was 123,540,000 barrels, or nearly half of the total output of the State in 1928, and represented an increase of 140 per cent over the 1927 output. Without this increase Texas would have remained third in rank as a producing State and the output of the country as a whole would have decreased materially. The most important factor in the rise of west Texas in 1928 was the rapid increase in output from the Hendricks field of Winkler County. This field yielded 62,045,000 barrels of oil in 1928, or slightly more than half of the west Texas total. The field was actively developed in the first half of the year and reached a peak of over 300,000 barrels a day in May, when a proration agreement was enacted and the allowable production was reduced about 50 per cent. The Hendricks field was extended several times during the year, until the proved territory reached a length of nearly 10 miles, with a width of about 3 miles. The future of the field was somewhat clouded by serious water encroachment, which, however, probably would not have been so pronounced had the field been developed more conservatively. The record of the Yates field in

1928 can be cited as one of the best examples of orderly and efficient development ever credited to the petroleum industry. Wells in this field were brought in steadily, but as soon as completed they were given a 1-hour production test and were then restricted to a small fraction of their output or were shut in entirely. A potential production equal to more than the total for the country was built up in this field—this potential production would be much less if the wells had been allowed to flow 24 hours—but the output in 1928 under the proration agreement was not allowed to go above 75,000 barrels a day. Output in Crane and Upton Counties, of which the Church and Fields pool supplies the major portion, declined in 1928, as did that in Big Lake, the next most important field. The Roberts-Settles area was materially extended both as to area and producing horizons, and the output was several times greater than in 1927.

The most important discovery in west Texas occurred in the Big Lake field, where a well of high-gravity oil was brought in at 8,525 feet. At the time of discovery this well was the deepest in the world, and the discovery was particularly important because it greatly enhanced the future possibilities of the entire Permian Basin. A number of new productive spots were discovered in west Texas in 1928. The most important were the Leck and O'Brien fields in Winkler County, the Skelly pool near the Big Lake field in Reagan County, the Pecos Valley pool in Pecos County, and the Shipley pool, the first producer in Ward County.

The rapid increase in production in west Texas greatly taxed the transportation facilities at first available, and a huge tank-building program became necessary to care for the surplus output. However, the completion of pipe lines to the Gulf and the construction of refineries in the west Texas area strengthened the market, and the crude prices quoted in contracts are reported to have increased gradually during the year.

The southwest Texas fields had a successful producing year in 1928. The output amounted to 3,276,000 barrels, as compared with 3,056,000 barrels in 1927. The two most active fields in the district were the Albercas and Cole-Bruni, both in Webb County. A number of new productive pools—productive of either oil or gas and often of both—were brought in. Although these did little to augment the production, they indicate a widespread occurrence of oil in the area.

Production in the Gulf or salt-dome fields amounted to 39,538,000 barrels in 1928, a decline of 7,465,000 barrels from that in 1927. The major portion of the decrease occurred in the Spindletop field, which, nevertheless, continued to outrank by far any one of the others in importance. A number of discoveries were made, the two most notable being the finding of prolific production at Gay Hill in Washington County and the opening up of the Sugarland field in Fort Bend County. The discovery at Gay Hill was particularly interesting from the standpoint of the geologist, as it marked the first time that production has been found in the Cook Mountain formation. Considerable effort was expended in attempting to obtain extensions to the older producing domes. Some measure of success attended such effort, and a number of fields—for example, Boling, South Liberty. High Island, and Pierce Junction—were extended. Geophysical work was continued with the usual secrecy, and a number of new domes were discovered. The majority of these were untested as the year closed.

Petroleum produced in Texas, 1919–1928, by districts

[Thousands of barrels of 42 U. S. gallons]

Year	Gulf coast (salt-dome pools)																							
	Batson	Big Creek	BlueRidge	Boling	Damon Mound	Dayton	Goose Creek[1]	High Island	Hull	Humble	Kingsville	Markham	Moore	Nash	Orange	Piedras Pintas	Pierce Junction	Saratoga	Sourlake	South Liberty	Spindletop	Sugarland	West Columbia	Other	Total
1919	560	------	------	------	191	8	5, 770	------	1, 273	3, 706	------	54	----	----	------	------	------	737	2, 709	------	407	----	5, 611	31	21, 057
1920	527	------	92	------	379	17	4, 476	------	3, 909	3, 607	------	57	----	----	------	------	------	849	2, 024	------	322	----	9, 459	17	25, 735
1921	495	------	326	------	666	40	4, 640	------	8, 150	3, 004	------	49	----	----	470	------	1, 239	1, 129	1, 802	------	344	----	12, 081	6	34, 441
1922	434	(2)	349	------	754	29	4, 766	------	6, 546	2, 284	------	35	----	----	5, 345	------	1, 020	713	1, 675	------	289	----	11, 126	5	35, 370
1923	403	(2)	287	------	628	35	6, 026	------	7, 300	2, 275	------	21	----	----	4, 649	------	313	626	1, 906	------	326	----	5, 994	32	30, 821
1924	464	293	278	------	520	36	3, 967	------	7, 074	2, 224	------	66	----	----	3, 958	------	154	543	1, 588	------	359	----	4, 536	22	26, 082
1925	432	310	313	40	416	20	3, 464	121	6, 944	1, 864	------	41	----	----	4, 816	17	265	514	1, 444	4, 416	412	----	4, 031	5	29, 885
1926	456	520	486	1, 175	341	(2)	3, 501	60	7, 058	1, 568	------	51	75	207	3, 458	93	948	482	2, 004	1, 992	13, 441	----	3, 197	[3] 22	41, 135
1927	462	1, 243	1, 210	753	312	(2)	3, 102	96	5, 685	1, 485	146	109	22	395	1, 803	(2)	2, 954	413	1, 593	1, 084	20, 751	----	3, 291	[4] [5] 94	[5] 47, 003
1928	550	811	2, 205	814	291	(2)	2, 726	163	4, 055	1, 242	153	112	44	491	1, 415	------	3, 899	343	1, 185	1, 398	14, 150	390	2, 800	[6] 301	39, 538

Year	Rest of State																							Total for State
	East and south central Texas										North central Texas [8]	Panhandle [9]	Southwest Texas [10]	West Texas									Total	
	Boggy Creek	Calliham	Luling	Lytton Springs	Mexia [7]	Raccoon Bend	Somerset-Medina	Thrall-Minerva-Rockdale	Other	Total				Big Lake	Chalk-Roberts	Crane-Upton	Hendricks	Westbrook	World	Yates	Other	Total		
1919	----	----	-------	------	269	----	43	91	60	463	57,846	-------	------	------	-------	-------	-------	-------	----	-------	----	--------	58,309	79,366
1920	----	----	-------	------	297	----	162	60	51	570	70,563	-------	------	------	-------	-------	-------	-------	----	-------	----	--------	71,133	96,868
1921	----	----	-------	------	6,137	----	324	52	48	6,561	65,164	-------	------	------	-------	-------	-------	-------	----	-------	----	--------	71,725	106,166
1922	----	----	-------	------	34,790	----	672	37	35	35,534	47,037	-------	733	------	-------	-------	-------	10	----	-------	----	10	83,314	118,684
1923	----	----	2,248	------	50,827	----	1,030	247	38	54,390	43,896	-------	1,786	12	-------	-------	-------	118	----	-------	----	130	100,202	131,023
1924	----	187	11,134	------	49,272	----	1,109	235	59	61,996	42,487	272	2,215	1,056	-------	-------	-------	414	----	-------	----	1,470	108,440	134,522
1925	----	98	8,979	2,603	42,353	----	873	255	58	55,219	46,013	1,132	2,688	8,900	-------	-------	-------	811	----	-------	----	9,711	114,763	144,648
1926	----	52	7,699	1,783	20,494	----	791	535	36	31,390	49,932	25,551	4,150	10,937	(11)	2,204	-------	[11] 1,372	237	(2)	8	14,758	125,781	166,916
1927	15	29	6,169	784	12,417	1	767	508	43	[5] 20,733	54,806	40,253	3,056	8,986	1,072	30,607	3,641	1,365	516	5,329	22	51,538	[5] 170,386	217,389
1928	331	24	5,443	846	8,353	98	738	337	51	16,221	49,459	25,286	3,276	6,753	[12] 5,736	25,529	62,045	(12)	796	22,429	252	123,540	217,782	257,320

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[1] Includes Barbers Hill.
[2] Included under "Other."
[3] Brenham and Dayton.
[4] Bernard, Brenham, Dayton, and Piedras Pintas.
[5] Revised figures.
[6] Bernard, Brenham, Dayton, Fannette, and Refugio.
[7] Includes Corsicana, Nigger Creek, Powell, Richland, Wortham, and smaller fields in Falls, Freestone, Limestone, and Navarro Counties.
[8] Includes the districts in and between Wilbarger, Wichita, Clay, Montague, and Cooke Counties on the north and Runnels, Coleman, Brown, and Comanche Counties on the south.
[9] Carson, Gray, Hutchinson, Moore, Potter, and Wheeler Counties.
[10] Includes fields in Jim Hogg, Webb, and Zapata Counties and Duval County, except salt-dome field at Piedras Pintas.
[11] Westbrook includes Chalk and other small fields in Howard and Mitchell Counties.
[12] Chalk-Roberts includes Westbrook.

Petroleum produced in coastal Texas salt-dome pools, 1927 and 1928, by districts and months

[Thousands of barrels of 42 U. S. gallons]

District	Petroleum transported from producing properties													Oil consumed on leases plus net change in producers' stocks, Jan. 1-Dec. 31	Production
	January	February	March	April	May	June	July	August	September	October	November	December	The year		
1927															
Batson	47	40	40	37	43	35	34	38	35	36	33	37	455	7	462
Big Creek	70	79	132	163	127	108	96	85	83	120	84	68	1,215	28	1,243
Blue Ridge	66	54	85	81	112	134	117	83	106	86	123	126	1,173	37	1,210
Boling	73	53	48	61	62	57	58	59	68	70	64	64	737	16	753
Damon Mound	25	27	25	24	26	23	24	25	23	25	18	24	289	23	312
Goose Creek [1]	237	200	248	290	285	252	262	276	264	265	254	235	3,068	34	3,102
High Island	11	19	15	16	8	6	4	3	1	1	-----	2	86	10	96
Hull	538	454	483	526	527	471	445	420	426	510	404	364	5,568	117	5,685
Humble	114	103	121	144	137	115	122	116	122	111	105	93	1,403	82	1,485
Markham	13	11	7	10	13	11	8	8	6	8	6	5	106	3	109
Moore	1	2	1	-----	4	3	2	1	2	1	2	2	21	1	22
Orange	172	142	157	160	167	163	161	152	140	127	119	117	1,777	26	1,803
Pierce Junction	182	196	246	206	260	232	186	172	219	304	351	389	2,943	11	2,954
Saratoga	27	52	52	101	27	32	42	71	31	31	21	42	529	−116	413
Sourlake	150	148	160	145	135	128	127	127	117	115	108	109	1,569	24	1,593
South Liberty	120	102	113	101	101	85	85	87	76	72	72	66	1,080	4	1,084
Spindletop	2,249	1,875	1,824	1,469	1,697	1,779	1,711	1,737	1,665	1,598	1,483	1,650	20,737	14	20,751
West Columbia [2]	373	315	336	318	302	299	300	278	300	290	294	290	3,695	−9	3,686
Other [3]	4	5	3	2	1	1	[4] 19	[4] 19	[4] 19	[4] 16	17	16	[4] 122	[4] 118	[4] 240
	4,472	3,877	4.096	3,854	4,034	3,934	[4]3,803	[4]3,757	[4]3,703	[4]3,786	3,558	3,699	[4]46,573	[4] 430	[4]47,003
1928															
Batson	40	37	40	36	40	38	40	38	36	39	37	37	458	92	550
Big Creek	59	59	55	42	45	42	92	96	91	72	67	72	792	19	811
Blue Ridge	122	112	183	199	234	163	210	238	231	198	164	140	2,194	11	2,205
Boling	63	63	77	64	89	64	61	56	46	50	61	100	794	20	814
Damon Mound	21	24	21	24	22	24	22	19	16	25	23	21	262	29	291
Goose Creek [1]	241	218	234	224	227	209	212	207	192	274	191	249	2,678	48	2,726
High Island	-----	8	6	3	5	12	12	12	12	13	21	43	147	16	163
Hull	345	317	333	313	367	331	311	321	343	372	323	312	3,988	67	4,055
Humble	104	98	106	97	97	91	95	104	102	119	91	102	1,206	36	1,242
Kingsville	36	20	16	11	9	10	8	8	9	9	9	9	154	−1	153
Markham	6	5	9	9	7	10	8	14	8	11	10	11	108	4	112
Moore	6	4	2	1	1	1	-----	12	7	3	2	2	41	3	44
Orange	129	118	124	137	132	130	114	106	100	106	104	96	1,396	19	1,415
Pierce Junction	278	246	305	345	423	329	343	331	293	350	292	342	3,877	22	3,899
Saratoga	19	19	19	18	70	45	35	30	30	51	34	35	405	−62	343
Sourlake	103	94	104	97	101	100	101	98	94	95	87	88	1,162	23	1,185
South Liberty	63	63	96	117	126	112	121	112	105	108	151	191	1,365	33	1,398
Spindletop	1,306	1,065	1,175	1,108	1,251	1,226	1,190	1,195	1,170	1,166	1,143	1,154	14,149	1	14,150
Sugarland	-----	-----	-----	9	7	7	9	5	12	61	133	143	386	4	390
West Columbia [2]	289	271	291	284	277	262	269	268	231	249	249	227	3,167	124	3,291
Other [5]	10	9	9	13	15	11	62	41	29	35	34	31	299	2	301
	3,240	2,850	3,205	3,151	3,545	3,217	3,315	3,311	3,157	3,406	3,226	3,405	39,028	510	39,538

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[1] Includes Barbers Hill.

[2] Includes 395,000 barrels produced in Nash in 1927 and 491,000 barrels in 1928.

[3] Bernard, Brenham, Dayton, Kingsville, and Piedras Pintas.

[4] Revised figures.

[5] Bernard, Brenham, Dayton, Fannette, and Refugio.

Petroleum produced in Texas (exclusive of salt-dome fields), 1927 and 1928, by districts and months

[Thousands of barrels of 42 U. S. gallons]

District	Petroleum transported from producing properties													Oil consumed on leases plus net change in producers' stocks, Jan. 1–Dec. 31	Production
	January	February	March	April	May	June	July	August	September	October	November	December	The year		
1927															
East and south central Texas:															
Calliham	3	2	3	3	2	3	3	3	2	2	2	1	29		29
Luling	553	496	543	529	535	508	506	489	477	482	468	469	6, 055	114	6, 169
Lytton Springs	80	68	72	69	64	62	60	60	61	61	64	57	778	6	784
Mexia	1, 344	1, 139	1, 217	1, 135	1, 101	1, 019	1, 003	968	902	903	848	823	12, 402	15	12, 417
Somerset-Medina	49	59	71	65	72	67	66	66	60	63	62	63	763	4	767
Thrall-Minerva-Rockdale	51	45	47	46	45	43	43	41	38	38	34	36	507	1	508
Other	2	2	2	3	3	3	[1] 5	[1] 5	[1] 5	[1] 3	3	4	[1] 40	[1] 19	[1] 59
	2, 082	1, 811	1, 955	1, 850	1, 822	1, 705	[1] 1, 686	[1] 1, 632	[1] 1, 545	[1] 1, 552	1, 481	1, 453	[1] 20, 574	[1] 159	[1] 20, 733
North central Texas	4, 905	4, 563	5, 208	4, 954	5, 061	4, 561	4, 440	4, 579	4, 317	4, 202	3, 967	3, 788	54, 545	261	54, 806
Panhandle	3, 982	3, 571	3, 583	3, 697	4, 120	3, 958	3, 396	3, 128	2, 909	2, 841	2, 549	2, 498	40, 232	21	40, 253
Southwest Texas	377	303	312	287	270	246	235	231	214	208	195	190	3, 068	−12	3, 056
West Texas:															
Big Lake	861	753	811	796	807	745	753	755	714	692	658	641	8, 986		8, 986
Chalk-Roberts	20	32	48	59	86	86	87	87	98	117	83	222	1, 025	47	1, 072
Crane-Upton	702	840	1, 182	1, 675	1, 920	2, 188	2, 784	3, 458	3, 685	3, 859	3, 620	3, 600	29, 513	1, 094	30, 607
Hendricks		14	20	29	32	41	46	87	260	398	779	1, 682	3, 388	253	3, 641
Westbrook	123	104	122	117	118	113	118	130	114	107	102	105	1, 373	−8	1, 365
World	31	32	32	32	31	38	42	43	46	53	62	64	506	10	516
Yates			105	45	404	193	159	169	364	925	1, 242	1, 587	5, 193	136	5, 329
Other	1	1	1	1	1	1	1	1	1	1	2	2	14	8	22
	1, 738	1, 776	2, 321	2, 754	3, 399	3, 405	3, 990	4, 730	5, 282	6, 152	6, 548	7, 903	49, 998	1, 540	51, 538
	13, 084	12, 024	13, 379	13, 542	14, 672	13, 875	[1] 13, 747	[1] 14, 300	[1] 14, 267	[1] 14, 955	14, 740	15, 832	[1] 168, 417	[1] 1, 969	[1] 170, 386

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[1] Revised figures.

Petroleum produced in Texas (exclusive of salt-dome fields), 1927 and 1928, by districts and months—Continued

[Thousands of barrels of 42 U. S. gallons]

District	Petroleum transported from producing properties													Oil consumed on leases plus net change in producers' stocks, Jan. 1–Dec. 31	Production
	January	February	March	April	May	June	July	August	September	October	November	December	The year		
1928															
East and south central Texas:															
Boggy Creek					5	2	10	15	21	48	51	166	318	13	331
Calliham	2	2	3	2	3	2	2	1	2	2	1	2	24		24
Luling	455	429	453	427	452	427	431	419	406	415	422	598	5,334	109	5,443
Lytton Springs	66	63	79	76	77	70	72	68	70	71	67	61	840	6	846
Mexia	950	714	763	701	717	660	664	674	646	674	618	615	8,396	−43	8,353
Somerset-Medina	59	62	64	63	63	61	62	62	59	61	58	58	732	6	738
Thrall-Minerva-Rockdale	34	31	32	30	30	28	27	27	25	25	24	24	337		337
Other	3	3	5	3	4	3	4	3	9	30	30	36	133	16	149
	1,569	1,304	1,399	1,302	1,351	1,253	1,272	1,269	1,238	1,326	1,271	1,560	16,114	107	16,221
North central Texas	3,805	3,609	3,907	3,845	4,026	4,042	4,430	4,614	4,335	4,440	4,211	4,214	49,478	−19	49,459
Panhandle	2,382	2,220	2,314	2,082	2,049	2,019	1,988	2,158	2,056	2,257	1,987	1,907	25,419	−133	25,286
Southwest Texas	195	174	184	201	202	236	266	266	301	424	397	400	3,246	30	3,276
West Texas:															
Big Lake	682	567	603	567	549	516	555	550	536	543	494	533	6,695	58	6,753
Chalk-Roberts [2]	294	209	216	214	214	214	231	349	664	926	1,009	1,151	5,691	45	5,736
Crane-Upton	3,105	2,737	2,569	2,257	2,286	1,971	2,125	1,892	1,723	1,712	1,571	1,497	25,445	84	25,529
Hendricks	2,467	3,274	5,311	6,739	5,956	5,235	6,190	6,047	5,557	5,276	4,856	5,199	62,107	−62	62,045
World	58	52	52	64	58	56	77	90	72	77	70	68	794	2	796
Yates	1,496	1,412	1,507	1,567	1,650	1,462	2,069	2,239	2,164	2,342	2,202	2,300	22,410	19	22,429
Other	5	9	9	6	9	21	24	30	32	35	31	38	249	3	252
	8,107	8,260	10,267	11,414	10,722	9,475	11,271	11,197	10,748	10,911	10,233	10,786	123,391	149	123,540
	16,058	15,567	18,071	18,844	18,350	17,025	19,227	19,504	18,678	19,358	18,099	18,867	217,648	134	217,782

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[2] Includes Westbrook.

Wyoming.—The production of crude petroleum in Wyoming in 1928 amounted to 21,461,000 barrels, an increase of 154,000 barrels over that in 1927. This increase, though small, was a surprising development as the number of completions was materially lower in 1928 than in 1927. Salt Creek, the major producing field, declined in output in 1928, as did the majority of the other fields; these losses, however, were more than compensated by production from the Oregon Basin field which had no commercial output in 1927. Production at Lost Soldier, which ranked second in output, showed a slight increase, but the output at Big Muddy, third in importance, fell below 1,000,000 barrels for the first time since 1918. Completions at Salt Creek in 1928 numbered less than one-fourth of the 1927 total, but this drastic curtailment in drilling activity was not reflected to any great extent in the production figures, as many of the new wells in 1927 were completed in the Lakota sand and were shut in, to be drawn on in 1928 sufficiently to cover market requirements. Many of the completions at Salt Creek in 1928 were carried to the Sundance sand to test the potentialities of that horizon, the deepest so far uncovered in the field. Although wildcatting in Wyoming in 1928 probably was less intense than for some time a considerable number of structures were tested. The majority of these wells were failures, but four important discoveries were made. Probably the most important of these was the finding of light oil in commercial quantities on the Alkali Butte structure. The other three new fields opened were Frannie, North Sunshine, and Bolton, all heavy-oil producers.

Petroleum produced in Wyoming, 1919–1928, by districts

[Thousands of barrels of 42 U. S. gallons]

Year	Big Muddy	Byron-Greybull-Torchlight	Elk Basin	Ferris	Grass Creek	Hamilton Dome-Warm Springs	La Barge	Lance Creek	Lander-Dallas-Derby Dome	Lost Soldier	Mule Creek
1919	3, 104	27	740	(1)	2, 049	--------	--------	461	62	[1] 167	--------
1920	2, 083	69	732	(1)	1, 573	57	--------	353	84	[1] 135	182
1921	1, 927	80	681	(1)	1, 435	67	--------	346	119	[1] 524	68
1922	1, 506	70	652	(1)	1, 784	111	--------	282	149	[1] 751	168
1923	1, 527	57	634	(1)	1, 589	216	--------	363	137	[1] 1, 551	--------
1924	1, 272	33	409	42	1, 113	239	--------	786	133	1, 733	178
1925	1, 223	30	314	33	1, 240	264	--------	360	152	1, 713	129
1926	1, 215	(2)	273	(1)	1, 025	319	70	540	165	[1] 2, 059	--------
1927	1, 072	28	337	(1)	974	313	341	269	246	[1] 1, 341	188
1928	962	25	360	(1)	871	298	490	217	247	[1] 1, 442	142

Year	Notches	Oregon Basin	Osage	Pilot Butte	Poison Spider-South Casper	Rex Lake	Rock Creek	Salt Creek	Teapot	Other	Total
1919	--------	--------	--------	91	--------	--------	242	6, 225	--------	4	13, 172
1920	--------	--------	16	69	--------	--------	1, 370	10. 090	--------	18	16, 831
1921	--------	--------	176	46	--------	--------	1, 681	12, 172	--------	11	19, 333
1922	--------	--------	182	38	--------	--------	1, 728	19, 248	37	9	26, 715
1923	61	--------	178	29	(2)	--------	1, 429	35, 770	1, 156	88	44, 785
1924	39	--------	146	29	229	41	1, 181	30, 874	1, 004	17	39, 498
1925	35	--------	109	25	297	20	1, 087	21, 445	632	65	29, 173
1926	34	--------	113	20	[3] 376	53	1, 029	18, 010	426	49	25, 776
1927	24	--------	107	17	247	44	982	14, 399	314	64	21, 307
1928	--------	882	133	19	327	18	928	14, 023	--------	77	21, 461

[1] Ferris included with Lost Soldier.

[2] Included under "Other."

[3] Includes Iron Creek and Simpson Ridge.

Petroleum produced in Wyoming, 1927 and 1928, by districts and months

[Thousands of barrels of 42 U. S. gallons]

District	Petroleum transported from producing properties													Oil consumed on leases plus net change in producers' stocks, Jan. 1-Dec. 31	Production
	January	February	March	April	May	June	July	August	September	October	November	December	The year		
1927															
Big Muddy	87	83	92	89	89	87	90	97	92	93	89	85	1,073	−1	1,072
Elk Basin	23	24	27	25	29	27	28	32	30	33	32	27	337	------	337
Grass Creek	84	75	86	78	79	84	84	83	81	84	81	77	976	−2	974
Hamilton Dome	-----	-----	35	41	31	35	44	30	29	29	14	18	306	2	308
La Barge	8	8	9	16	19	19	30	37	29	28	52	71	326	15	341
Lance Creek	23	21	21	18	16	18	19	17	41	36	19	18	267	2	269
Lander-Dallas	18	14	14	14	17	17	18	18	23	30	28	28	239	7	246
Lost Soldier-Ferris	161	125	136	135	109	44	152	127	108	104	103	132	1,436	−95	1,341
Mule Creek	-----	-----	-----	-----	39	30	21	23	20	19	19	17	188	------	188
Osage	9	10	9	9	10	9	8	9	9	10	10	7	109	−2	107
Poison Spider-South Casper	29	23	25	23	22	22	26	25	18	19	11	4	247	------	247
Rex Lake	6	5	5	6	4	3	3	4	5	3	-----	-----	44	------	44
Rock Creek	82	81	88	85	82	82	85	82	82	79	76	77	981	1	982
Salt Creek	1,312	1,195	1,289	1,294	1,340	1,267	1,318	1,109	984	1,004	1,065	1,228	14,405	−6	14,399
Teapot	28	25	31	25	29	26	28	28	24	27	21	22	314	------	314
Other	4	3	4	6	8	8	15	13	25	15	4	2	107	31	138
	1,874	1,692	1,871	1,864	1,923	1,778	1,969	1,734	1,600	1,613	1,624	1,813	21,355	−48	21,307
1928															
Big Muddy	83	78	84	80	84	79	80	86	81	79	75	73	962	------	962
Elk Basin	28	31	32	32	32	34	33	29	27	30	27	25	360	------	360
Grass Creek	75	72	74	73	77	74	73	74	68	70	69	69	868	3	871
Hamilton Dome	31	30	48	30	30	40	35	30	-----	-----	9	13	296	2	298
La Barge	36	39	26	25	25	20	12	12	53	86	74	76	484	6	490
Lance Creek	18	19	22	21	22	18	18	16	14	13	11	12	204	13	217
Lander-Dallas	30	20	22	23	22	20	21	19	18	17	13	16	241	6	247
Lost Soldier-Ferris	33	29	236	149	201	130	136	143	122	120	117	110	1,526	−84	1,442
Mule Creek	-----	-----	-----	-----	-----	19	29	25	19	20	18	13	143	−1	142
Oregon Basin	-----	15	26	10	31	40	85	137	120	174	110	90	838	44	882
Osage	11	11	10	11	9	8	11	13	10	12	11	11	128	5	133
Poison Spider-South Casper	12	25	26	37	17	17	17	28	27	28	33	28	295	32	327
Rex Lake	-----	-----	-----	-----	-----	-----	-----	-----	4	5	5	4	18	------	18
Rock Creek	76	73	78	74	79	78	85	87	79	79	75	68	931	−3	928
Salt Creek	1,298	1,096	1,187	1,155	1,267	1,253	1,196	1,197	1,154	1,220	1,070	1,010	14,103	−80	14,023
Other	2	2	5	4	9	5	8	12	15	8	12	15	97	24	121
	1,733	1,540	1,876	1,724	1,905	1,835	1,839	1,908	1,811	1,961	1,729	1,633	21,494	−33	21,461

Other States.—The most important event in the fields of the eastern and central States classified as "Other States" was a fairly general increase in prices, amounting to more than $1 a barrel in certain districts. This increase served to stimulate drilling, particularly during the last quarter of the year, and the output of the nine States included under this classification rose from 40,448,000 barrels in 1927 to 40,748,000 barrels in 1928.

Production in Pennsylvania, the most important of these States, increased nearly 5 per cent over that in 1927. A portion of this increase and also of that in New York State resulted from the opening up of small pumpers made profitable by the increase in the price of crude, but the major portion occurred in the Bradford district. Completions in this district were less than in 1927, but the decrease in number was more than compensated by the growth of water flooding. This method of stimulating production progressed in efficiency in 1928 and overshadowed repressuring with air or gas.

Production in both West Virginia and Ohio fell off in 1928 as wildcatting failed to uncover any new field of importance. Ohio witnessed a material increase in the number of gas wells completed, and the natural gas found a ready market.

Kentucky experienced a profitable year in 1928. The increase of nearly 10 per cent in production and the increase in price resulted in a material improvement in outlook. The major portion of the activity in Kentucky was in the western half of the State and centered in Ohio and Daviess Counties. As illustrative of the growth in importance of this area the records of the Kentucky State Tax Commission show the output of Daviess County in 1928 as 661,002 barrels, as compared with only 48,925 barrels in 1927.

Production in Indiana in 1928 was considerably above that in 1927; Illinois, however, experienced another dull year and again declined in output. Fewer wells were completed in these States in 1928, and wildcatting was generally unsuccessful.

In Michigan the year 1928 witnessed the development of the Muskegon field but the decline of the Saginaw field to a small fraction of its 1927 importance. A number of comparatively large producers were completed at Muskegon but their decline was rapid. The total production for the State amounted to 594,000 barrels, as compared with 439,000 barrels in 1927.

Sporadic attempts were made to extend the producing areas of Tennessee in 1928, but in general the only success that followed was the proving of a gas reserve of some importance.

Petroleum produced in other States in 1928

[Thousands of barrels of 42 U. S. gallons]

State	Rank	Production	Percentage of increase or decrease from 1927	State	Rank	Production	Percentage of increase or decrease from 1927
Pennsylvania	8	9,956	+4.5	Indiana	16	1,052	+23.5
Kentucky	9	7,359	+9.5	Michigan	18	594	+35.3
Ohio	10	7,015	−7.6	Tennessee	19	46	--23.3
Illinois	11	6,462	−7.6				
West Virginia	12	5.661	−6.0		--------	40,748	+.7
New York	15	2,603	+16.1				

Petroleum produced in Kentucky, 1924–1928, by counties, in barrels [1]

County	1924	1925	1926	1927	1928
Allen	371. 460	304, 579	280, 228	254, 745	229, 306
Barren	108, 457	253, 561	341, 812	362, 510	489, 226
Bath	17, 685	16, 805	14, 872	12, 372	8, 091
Boyd	1, 242	992	712	783	497
Breckinridge	----------	----------	----------	----------	240
Clinton	1, 363	11, 031	11, 894	44, 336	1, 573
Cumberland	81, 217	69, 805	45, 317	55, 432	24, 676
Daviess	----------	12, 321	22, 487	48, 925	661, 002
Elliott	7, 271	8, 240	9, 727	9, 278	8, 571
Estill	498, 957	436, 483	401, 876	374, 772	340, 820
Floyd	14, 126	7, 873	13, 494	7, 187	7, 695
Hancock	36, 657	33, 578	30, 999	22, 665	16, 117
Hopkins	12, 912	15, 073	14, 692	11, 305	9, 062
Jackson	582	583	1, 239	1, 175	1, 298
Johnson	1, 178, 675	1, 026, 322	968, 284	862, 909	707, 657
Knott	2, 922	2, 634	1, 876	2, 022	1, 857
Lawrence	512, 286	665, 795	688, 124	631, 420	533, 734
Lee	2, 236, 840	1, 775, 004	1, 449, 526	1, 248, 195	1, 091, 394
Lincoln	114	50	----------	----------	----------
Logan	----------	564	661	433	482
Magoffin	1, 105, 378	890, 117	780. 901	706, 256	588, 820
Martin	12	3	11	19	----------
McCreary	4, 405	3, 751	6, 418	9, 537	8, 209
McLean	----------	----------	----------	----------	2, 578
Menifee	3, 156	1, 936	1, 573	1, 613	894
Monroe	48, 491	22, 621	6, 788	3, 857	2, 805
Morgan	9, 410	8, 148	6, 999	6, 356	5, 446
Ohio	78, 631	165, 040	362, 909	1, 326, 055	2, 022, 446
Owsley	10, 879	16, 167	13, 605	19, 976	9, 879
Powell	264, 483	212, 582	172, 688	146, 546	125, 414
Russell	9, 409	1, 917	----------	----------	----------
Simpson	11, 252	8, 953	7, 089	5, 268	4, 000
Warren	580, 225	489, 646	408, 807	320, 587	253, 451
Wayne	126, 139	134, 142	108, 229	90, 844	86, 983
Wolfe	57, 557	52, 538	53, 969	54, 644	56, 866
	7, 392, 193	6, 648, 854	6, 227, 806	6, 642, 022	7, 301, 089
Bureau of Mines	7, 407, 000	6, 759, 000	6, 274, 000	6, 719, 000	7, 359, 000

[1] Kentucky State Tax Commission.

Petroleum produced in Pennsylvania, 1924–1928, by counties, in barrels [1]

County	1924	1925	1926	1927	1928
Allegheny	467, 265	453, 648	422, 797	406, 771	375, 062
Armstrong	21, 350	20, 093	19, 718	19, 420	18, 319
Beaver	91, 973	83, 908	84, 296	81, 198	77, 153
Butler	735, 900	846, 151	689, 782	677, 004	646, 942
Clarion	203, 685	208, 807	209, 965	190, 365	189, 740
Crawford	56, 613	57, 637	64, 523	75, 235	79, 482
Elk	100, 701	93, 546	88, 419	86, 213	85, 643
Forest	87, 369	131, 162	137, 078	127, 814	160, 577
Greene	249, 871	302, 938	439, 576	370, 612	228, 199
Jefferson	8, 436	8, 527	21, 167	7, 687	6, 744
Lawrence	24, 215	22, 537	19, 348	27, 319	24, 921
McKean	[2] 2, 374, 775	[2] 2, 575, 089	[2] 2, 962, 698	5, 535, 157	5, 901, 394
Mercer	13, 503	13, 804	14, 401	14, 031	15, 489
Potter	10, 011	11, 686	7, 395	6, 860	8, 849
Tioga	6, 836	5, 916	2, 441	----------	----------
Venango	1, 236, 568	1, 184, 221	1, 161, 924	1, 214, 568	1, 147, 047
Warren	326, 852	294, 597	313, 808	343, 315	299, 282
Washington	478, 483	455, 554	449, 493	455, 807	500, 019
Westmoreland	257	186	----------	----------	----------
	[2] 6, 494, 663	[2] 6, 770, 007	[2] 7, 108, 829	9, 639, 376	9, 764, 862
Bureau of Mines	[2] 7, 486, 000	[2] 8, 097, 000	[2] 8, 961, 000	9, 526, 000	9, 956, 000

[1] Department of Internal Affairs, Pennsylvania.

[2] Differences in totals (1924–1926) due mainly to differences in production recorded for McKean County.

WORLD PRODUCTION

The world production of crude petroleum during 1928 amounted to 1,324,734,000 barrels, an increase over 1927 of 62,152,000 barrels, or about 5 per cent. Domestic production in 1928 was but slightly greater than in 1927; hence nearly all the increase was recorded outside the United States. In consequence, the ratio of the United States production to the world total dropped from 71.4 per cent in 1927 to 68 per cent in 1928. The most important factor in the increased output of the world was a gain of nearly 43,000,000 barrels in production in Venezuela. (See fig. 33.) The most important decrease occurred in Mexico, where production has declined steadily since 1921. On the percentage basis the most important gains in production among the countries occurred in Ecuador and Iraq, in both of which the output more than doubled in 1928.

Venezuela.—Venezuela, with a production of 105,749,000 barrels in 1928 as compared with 63,134,000 barrels in 1927, showed the largest increase in quantity and moved from fourth to second place among the oil-producing countries; its output was 8 per cent of the world total in 1928, as compared with 5 per cent in 1927. The output of the Lagunillas field increased from 28,826,000 barrels in 1927 to 61,554,000 barrels in 1928. This increase of 33,000,000 barrels was the chief factor in the enhanced output of Venezuela as well as of the world. The output of the La Rosa and Mene Grande fields also showed substantial increases.

Russia.—The production in Russia in 1928 amounted to 84,704,000 barrels as compared with 77,018,000 barrels in 1927. This increase resulted from gusher production in the Surakhani and Bibi-Eibat fields in the Baku district and in the new Grozny field, as well as from increased production by pumping. Discovery of a new pool was reported at Kara-Chukhur in the Baku area.

Mexico.—Production in Mexico in 1928 amounted to 50,151,000 barrels, a material decrease from that in 1927. Mexico, which ranked either second or third from 1911 to 1927, dropped to fourth place in 1928, being passed by Venezuela.

Other countries.—Production in Persia, Netherland East Indies, and Rumania continued to increase, and these countries retained their respective positions as fifth, sixth, and seventh among the oil-producing countries. Trinidad, with a production of 7,684,000 barrels, drew closer to British India and threatened that country's position as the leading producer among the British Colonies. The Palo Seco area, which produced about 18,000 barrels per month in 1927, was reported to be averaging that amount per week at the close of 1928. Other countries not mentioned above, which recorded a material percentage gain in output in 1928, were Russian Sakhalin, Egypt, Colombia, and Canada.

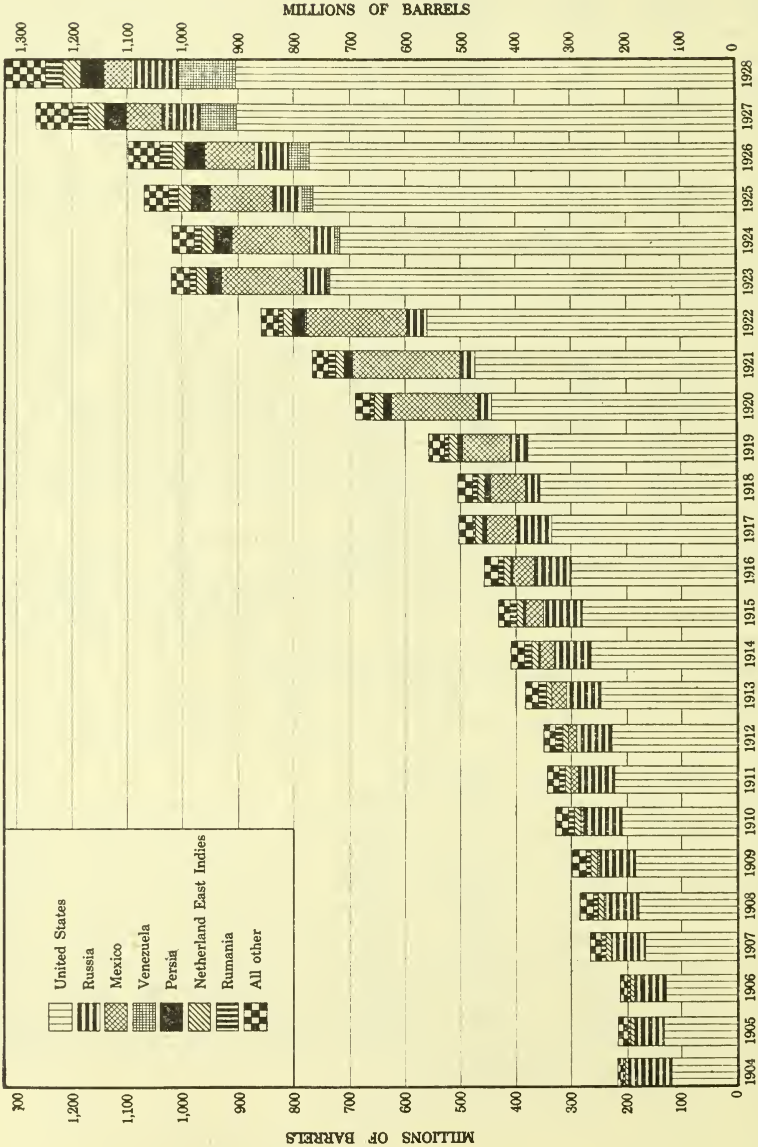

FIGURE 33.—World production of crude petroleum, 1904-1928, by countries

World production of crude petroleum,

[Thousands of barrels

Year	Rumania	United States	Italy	Canada	Russia [1]	Poland (Galicia)	Japan and Taiwan	Germany	India	Netherland East Indies	Peru	Mexico	Argentina
1857-60	19	502	(3)	------	------	------	------	------	------	------	------	------	------
1861	17	2,114	(3)	------	------	------	------	------	------	------	------	------	------
1862	23	3,057	(3)	12	------	------	------	------	------	------	------	------	------
1863	28	2,611	(3)	83	41	------	------	------	------	------	------	------	------
1864	33	2,116	(3)	90	65	------	------	------	------	------	------	------	------
1865	39	2,498	2	110	67	------	------	------	------	------	------	------	------
1866	42	3,598	1	175	83	------	------	------	------	------	------	------	------
1867	51	3,347	1	190	120	------	------	------	------	------	------	------	------
1868	56	3,646	(3)	200	88	------	------	------	------	------	------	------	------
1869	59	4,215	(3)	220	202	------	------	------	------	------	------	------	------
1870	84	5,261	(3)	250	204	------	------	------	------	------	------	------	------
1871	90	5,205	(3)	270	165	------	------	------	------	------	------	------	------
1872	91	6,293	(3)	308	185	------	------	------	------	------	------	------	------
1873	104	9,894	(3)	365	475	------	------	------	------	------	------	------	------
1874	103	10,927	1	169	583	150	------	------	------	------	------	------	------
1875	108	8,788	1	220	697	158	5	------	------	------	------	------	------
1876	111	9,133	3	312	1,321	164	7	------	------	------	------	------	------
1877	108	13,350	3	312	1,801	170	10	------	------	------	------	------	------
1878	109	15,397	4	312	2,401	176	18	------	------	------	------	------	------
1879	110	19,914	3	575	2,761	215	23	------	------	------	------	------	------
1880	115	26,286	2	350	3,001	229	26	9	------	------	------	------	------
1881	122	27,661	1	275	3,601	287	17	29	------	------	------	------	------
1882	136	30,350	2	275	4,538	330	15	58	------	------	------	------	------
1883	139	23,450	2	250	6,002	365	20	27	------	------	------	------	------
1884	211	24,218	3	250	10,805	408	28	46	------	------	------	------	------
1885	193	21,859	2	250	13,925	465	30	41	------	------	------	------	------
1886	168	28,065	2	584	18,006	306	38	74	------	------	------	------	------
1887	182	28,283	1	526	18,368	344	29	74	------	------	------	------	------
1888	219	27,612	1	695	23,049	467	37	85	------	------	------	------	------
1889	298	35,164	1	705	24,609	515	53	68	94	------	------	------	------
1890	383	45,824	3	795	28,691	659	52	108	118	------	------	------	------
1891	488	54,293	8	755	34,573	631	53	109	190	------	------	------	------
1892	593	50,515	18	780	35,775	646	69	101	242	------	------	------	------
1893	535	48,431	19	798	40,457	693	106	100	299	600	------	------	------
1894	508	49,344	21	829	36,375	949	173	123	327	688	------	------	------
1895	576	52,892	26	726	46,140	1,453	170	121	372	1,216	------	------	------
1896	543	60,960	18	727	47,221	2,444	237	145	430	1,427	47	------	------
1897	571	60,476	14	710	54,399	2,226	262	166	546	2,552	71	------	------
1898	776	55,364	15	758	61,610	2,376	319	184	542	2,964	71	------	------
1899	1,426	57,071	16	808	65,955	2,314	539	192	941	1,796	89	------	------
1900	1,629	63,621	12	913	75,780	2,347	871	358	1,079	2,253	274	------	------
1901	1,678	69,389	16	757	85,168	3,251	1,117	314	1,431	4,014	275	10	------
1902	2,060	88,767	19	531	80,540	4,142	996	354	1,617	2,430	287	40	------
1903	2,763	100,461	18	487	75,591	5,235	1,209	446	2,510	5,770	278	75	------
1904	3,599	117,081	26	553	78,537	5,947	1,219	637	3,385	6,508	290	126	------
1905	4,421	134,717	44	634	54,960	5,766	1,347	561	4,137	7,850	373	251	------
1906	6,378	126,494	54	569	58,897	5,468	1,564	579	4,016	8,181	531	502	------
1907	8,118	166,095	60	789	61,851	8,456	1,718	757	4,344	9,983	751	1,005	(3)
1908	8,252	178,527	51	528	62,187	12,612	1,871	1,009	5,047	10,283	945	3,933	12
1909	9,327	183,171	42	421	65,970	14,933	1,887	1,019	6,677	11,042	1,411	2,714	18
1910	9,724	209,557	51	316	70,337	12,673	1,829	1,032	6,138	11,031	1,258	3,634	20
1911	11,108	220,449	75	291	66,184	10,519	1,737	1,017	6,451	12,173	1,465	12,553	13
1912	12,976	222,935	54	243	68,019	8,535	1,659	1,031	7,117	10,846	1,752	16,558	47
1913	13,555	248,446	47	228	62,834	7,818	1,940	857	7,930	11,172	2,071	25,696	131
1914	12,827	265,763	40	215	67,020	6,436	2,636	781	7,410	11,422	1,837	26,235	276
1915	12,030	281,104	44	215	68,548	5,352	2,928	703	8,202	11,920	2,579	32,911	513
1916	8,945	300,767	51	198	65,817	6,587	2,963	656	8,491	12,547	2,593	40,546	867
1917	3,721	335,316	41	214	63,072	6,228	2,861	642	8,079	13,180	2,577	55,293	1,218
1918	8,730	355,928	35	305	27,168	6,032	2,441	270	8,188	12,778	2,527	63,828	1,353
1919	6,618	378,367	35	241	31,752	6,096	2,238	265	8,736	15,508	2,628	87,073	1,331
1920	7,435	442,929	35	196	25,430	5,607	2,221	246	8,375	17,529	2,817	157,069	1,651
1921	8,368	472,183	32	188	28,968	5,167	2,233	274	8,734	16,958	3,699	193,398	2,036
1922	9,843	557,531	31	179	35,692	5,227	2,055	319	8,529	17,066	5,314	182,278	2,866
1923	10,867	732,407	34	170	39,147	5,402	1,804	346	8,406	19,870	5,699	149,585	3,400
1924	13,369	713,940	39	161	45,355	5,657	1,814	406	8,416	20,473	8,379	139,678	4,639
1925	16,650	763,743	61	332	52,448	5,960	1,915	541	8,274	21,422	9,232	115,515	6,336
1926	23,314	770,874	41	364	64,311	5,844	1,785	653	8,011	21,243	10,762	90,421	7,851
1927	26,368	901,129	47	477	77,018	5,342	1,789	663	8,032	27,459	10,127	64,121	8,630
1928	30,773	901,474	46	624	[5] 84,704	5,493	1,944	630	8,741	32,118	12,006	50,151	9,070
	305,013	11,243,149	1,375	27,358	2,331,664	213,272	56,927	19,226	190,604	396,272	95,015	1,515,199	52,278

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[1] Exclusive of Sakhalin, which is shown separately.
[2] Estimated.
[3] Less than 1,000.
[4] Production in previous years credited to Germany.

1857–1928, by years and countries

of 42 U. S. gallons]

Trinidad	Egypt	Persia	Sarawak	Algeria	Ecuador	Venezuela	France	England	Czechoslovakia	Sakhalin (Russian)	Colombia	Iraq	Other countries [2]	Total	Percentage produced by United States
------	------	------	------	------	------	------	------	------	------	------	------	------	------	521	96
------	------	------	------	------	------	------	------	------	------	------	------	------	------	2,131	99
------	------	------	------	------	------	------	------	------	------	------	------	------	------	3,092	99
------	------	------	------	------	------	------	------	------	------	------	------	------	------	2,763	94
------	------	------	------	------	------	------	------	------	------	------	------	------	------	2,304	92
------	------	------	------	------	------	------	------	------	------	------	------	------	------	2,716	92
------	------	------	------	------	------	------	------	------	------	------	------	------	------	3,899	92
------	------	------	------	------	------	------	------	------	------	------	------	------	------	3,709	90
------	------	------	------	------	------	------	------	------	------	------	------	------	------	3,990	91
------	------	------	------	------	------	------	------	------	------	------	------	------	------	4,696	90
------	------	------	------	------	------	------	------	------	------	------	------	------	------	5,799	91
------	------	------	------	------	------	------	------	------	------	------	------	------	------	5,730	91
------	------	------	------	------	------	------	------	------	------	------	------	------	------	6,877	92
------	------	------	------	------	------	------	------	------	------	------	------	------	------	10,838	91
------	------	------	------	------	------	------	------	------	------	------	------	------	------	11,933	92
------	------	------	------	------	------	------	------	------	------	------	------	------	------	9,977	88
------	------	------	------	------	------	------	------	------	------	------	------	------	------	11,051	83
------	------	------	------	------	------	------	------	------	------	------	------	------	------	15,754	85
------	------	------	------	------	------	------	------	------	------	------	------	------	------	18,417	84
------	------	------	------	------	------	------	------	------	------	------	------	------	------	23,601	84
------	------	------	------	------	------	------	------	------	------	------	------	------	------	30,018	88
------	------	------	------	------	------	------	------	------	------	------	------	------	------	31,993	86
------	------	------	------	------	------	------	------	------	------	------	------	------	------	35,704	85
------	------	------	------	------	------	------	------	------	------	------	------	------	------	30,255	78
------	------	------	------	------	------	------	------	------	------	------	------	------	------	35,969	67
------	------	------	------	------	------	------	------	------	------	------	------	------	------	36,765	59
------	------	------	------	------	------	------	------	------	------	------	------	------	------	47,243	59
------	------	------	------	------	------	------	------	------	------	------	------	------	------	47,807	59
------	------	------	------	------	------	------	------	------	------	------	------	------	------	52,165	53
------	------	------	------	------	------	------	------	------	------	------	------	------	------	61,507	57
------	------	------	------	------	------	------	------	------	------	------	------	------	------	76,633	60
------	------	------	------	------	------	------	------	------	------	------	------	------	------	91,100	60
------	------	------	------	------	------	------	------	------	------	------	------	------	------	88,739	57
------	------	------	------	------	------	------	------	------	------	------	------	------	------	92,038	53
------	------	------	------	------	------	------	------	------	------	------	------	------	------	89,337	55
------	------	------	------	------	------	------	------	------	------	------	------	------	------	103,692	51
------	------	------	------	------	------	------	------	------	------	------	------	------	------	114,199	53
------	------	------	------	------	------	------	------	------	------	------	------	------	------	121,993	50
------	------	------	------	------	------	------	------	------	------	------	------	------	------	124,979	44
------	------	------	------	------	------	------	------	------	------	------	------	------	------	131,147	44
------	------	------	------	------	------	------	------	------	------	------	------	------	------	149,137	43
------	------	------	------	------	------	------	------	------	------	------	------	------	20	167,440	41
------	------	------	------	------	------	------	------	------	------	------	------	------	26	181,809	49
------	------	------	------	------	------	------	------	------	------	------	------	------	36	194,879	52
------	------	------	------	------	------	------	------	------	------	------	------	------	40	217,948	54
------	------	------	------	------	------	------	------	------	------	------	------	------	30	215,091	63
------	------	------	------	------	------	------	------	------	------	------	------	------	30	213,263	59
------	------	------	------	------	------	------	------	------	------	------	------	------	30	263,957	63
(3)	------	------	------	------	------	------	------	------	------	------	------	------	30	285,287	63
57	------	------	------	------	------	------	------	------	------	------	------	------	20	298,709	61
143	------	------	------	------	------	------	------	------	------	------	------	------	20	327,763	64
285	21	------	------	------	------	------	------	------	------	------	------	------	20	344,361	64
437	214	------	------	------	------	------	------	------	------	------	------	------	20	352,443	63
504	98	1,857	141	------	------	------	------	------	------	------	------	------	20	385,345	64
644	753	2,910	318	1	------	------	------	------	------	------	------	------	20	407,544	65
750	212	3,616	392	4	------	------	------	------	------	------	------	------	10	432,033	65
929	404	4,477	629	8	------	------	------	------	------	------	------	------	25	457,500	66
1,602	943	7,147	542	9	57	120	------	------	------	------	------	------	29	502,891	67
2,082	1,935	8,623	504	7	[2] 60	333	[4] 363	------	------	------	------	------	25	503,515	71
1,841	1,517	10,139	596	5	[2] 60	425	334	2	48	------	------	------	20	555,875	68
2,083	1,042	12,230	1,020	4	[2] 60	457	356	3	69	------	------	------	20	688,884	64
2,354	1,255	16,673	1,411	3	[2] 60	1,433	389	3	94	2	67	------	20	766,002	62
2,445	1,188	22,247	2,849	9	[2] 60	2,201	496	1	120	7	323	------	22	858,898	65
3,051	1,054	25,230	3,940	9	87	4,201	494	1	74	9	425	------	24	1,015,736	72
4,057	1,122	32,373	4,163	11	[2] 100	9,042	497	2	76	80	445	------	24	1,014,318	70
4,387	1,226	35,038	4,257	12	160	19,687	459	3	158	87	1,007	------	23	1,068,933	71
4,971	1,188	35,842	4,942	9	214	36,911	478	2	150	181	6,444	------	17	1,096,823	70
5,380	1,267	39,688	4,943	8	537	63,134	504	2	112	440	15,014	338	13	1,262,582	71
7,684	1,842	43,461	[6] 5,223	8	1,084	105,749	512	[7] 1	94	677	19,897	713	15	1,324,734	68
45,686	17,281	301,551	35,870	107	2,539	243,693	4,882	20	995	1,483	43,622	1,051	649	17,146,781	66

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[4] Year ended Sept. 30. [6] Includes a small production from Brunei. [7] Actual figure 604 barrels.

World production of petroleum in 1928, by countries, compared with 1927

[Compiled by L. M. Jones, of the Bureau of Mines]

Country	1928				1927			
	Thousands of barrels of 42 U. S. gallons	Thousands of metric tons	Thousands of cubic meters	Percentage of total by volume	Thousands of barrels of 42 U. S. gallons	Thousands of metric tons	Thousands of cubic meters	Percentage of total by volume
United States	901, 474	123, 592	143, 319	68. 0	901, 129	123, 486	143, 264	71. 4
Venezuela	105, 749	15, 711	16, 812	8. 0	63, 134	9, 384	10, 037	5. 0
Russia [1]	[2] 84, 704	[2] 11, 634	[2] 13, 467	6. 4	77, 018	10, 554	12, 245	6. 1
Mexico	50, 151	7, 585	7, 973	3. 8	64, 121	9, 728	10, 194	5. 1
Persia	43, 461	5, 763	6, 910	3. 3	39, 688	5, 326	6, 310	3. 2
Netherland East Indies	32, 118	4, 308	5, 106	2. 4	27, 459	3, 694	4, 366	2. 2
Rumania	30, 773	4, 282	4, 892	2. 3	26, 368	3, 669	4, 192	2. 1
Colombia	19, 897	2, 841	3, 163	1. 5	15, 014	2, 144	2, 387	1. 2
Peru	12, 006	1, 592	1, 909	. 9	10, 127	1, 341	1, 610	. 8
Argentina	9, 070	1, 323	1, 442	. 7	8, 630	1, 263	1, 372	. 7
India, British	8, 741	1, 227	1, 390	. 7	8, 032	1, 128	1, 277	. 6
Trinidad	7, 684	1, 139	1, 222	. 6	5, 380	797	855	. 4
Poland	5, 493	743	873	. 4	5, 342	723	849	. 4
British Borneo: Sarawak	[3] 5, 223	[3] 752	[3] 830	. 4	4, 943	712	786	. 4
Japan (including Taiwan)	1, 944	270	309	. 1	1, 789	248	284	. 1
Egypt	1, 842	268	293	. 1	1, 267	185	201	. 1
Ecuador	1, 084	154	172	. 1	537	76	85	. 2
Iraq	713	95	113	. 3	338	45	54	
Sakhalin, Russian	677	106	108		440	69	70	
Germany	630	92	100		663	97	105	
Canada	624	78	99		477	60	76	
France	512	74	81		504	73	80	
Czechoslovakia	94	14	15		112	16	18	
Italy	46	6	7		47	6	7	
Algeria	8	3	4		8	3	4	
Cuba	5				3			
England	[4] 1				2			
Other countries [5]	10				10			
	1, 324, 734	183, 652	210, 609	100. 0	1, 262, 582	174, 827	200, 728	100. 0

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[1] Exclusive of Sakhalin, which is shown separately.

[2] Year ended Sept. 30.

[3] Includes a small production from Brunei.

[4] Actual figure 604 barrels.

[5] Estimated.

PRODUCTION OF PETROLEUM IN FOREIGN COUNTRIES IN 1928, BY FIELDS

Petroleum produced in certain foreign countries in 1928, by provinces, districts, or fields

[Compiled by L. M. Jones, of the Bureau of Mines]

	Barrels of 42 U. S. gallons	Metric tons
Argentina:		
Comodoro Rivadavia	8, 196, 065	1, 205, 641
Plaza Huincul	761, 845	103, 230
Other fields	112, 333	14, 254
	9, 070, 243	1, 323, 125
Canada:		
Alberta	483. 454	58, 353
New Brunswick	7, 962	1, 057
Ontario—		
Bothwell	24, 255	3, 316
Oil Springs	35, 653	4, 785
Petrolia and Enniskillen	60, 547	8, 434
Other fields	12, 313	1, 683
	132, 768	18, 218
	624,184	77,628

	Barrels of 42 U. S. gallons	Metric tons
Colombia: Infantas	19, 896, 797	2, 841, 263
Ecuador: Santa Elena	1, 083, 676	153, 882
Egypt:		
Abu-Durba	5, 562	860
Hurghada	1, 836, 401	267, 463
	1, 841, 963	268, 323
France:		
Alsace—Pechelbronn	494, 687	71, 725
Herault—Gabian	17, 065	2, 185
	511, 752	73, 910
Germany:		
Hildesheim	45, 957	6, 714
Lüneburg	583, 803	85, 289
Other fields	287	42
	630, 047	92, 045

Petroleum produced in certain foreign countries in 1928, by provinces, districts, or fields—Continued

	Barrels of 42 U. S. gallons	Metric tons
Iraq:		
Baba Gurgur	244, 403	32, 587
Naft Khana	468, 450	62, 460
	712, 853	95, 047
Italy:		
Abruzzi—Pescara	377	58
Emilia—		
Parma	9, 643	1, 254
Piacenza	30, 355	3, 755
Rome—Frosinone	6, 024	927
	46, 399	5, 994
Mexico:		
Heavy oil—		
Altamira	257, 456	40, 034
Ebano	6, 954, 941	1, 091, 230
El Limon	687, 352	107, 502
Panuco—		
Cacalilao	9, 028, 477	1, 409, 345
Other	7, 373, 855	1, 151, 059
San Jeronimo	127, 071	19, 632
Topila	1, 102, 172	168, 963
	25, 531, 324	3, 987, 765
Light oil—		
Alazan	227, 830	32, 990
Belen	1, 151	152
Cerro Viejo	703, 153	101, 606
Chiconcillo and San Miguel	122, 699	18, 049
Concepcion	4, 617	662
Dos Bocas	20, 858	2, 989
Filisola	2, 618, 363	384, 638
Furbero	97, 929	14, 151
Jardin and Paso Real	3, 642, 998	526, 049
Mecatepec	130, 348	17, 167
Potrero del Llano	533, 467	77, 459
San Isidro	76, 939	11, 025
Sarlat	69	9
Teapa	1, 421	204
Tecuanapa	10, 379	1, 487
Tepetate, Chinampa, Amatlan, and Zacamixtle	5, 812, 186	854, 973
Tierra Amarilla	51, 672	7, 549
Tierra Blanca, Chapapote, and Alamo	3, 678, 751	534, 155
Tonala	136, 877	19, 135
Toteco and Cerro Azul	6, 747, 579	993, 244
	24, 619, 286	3, 597, 693
	50, 150, 610	7, 585, 458

	Barrels of 42 U. S. gallons	Metric tons
Netherland East Indies:		
Borneo	19, 213, 486	2, 652, 331
Ceram	302, 529	40, 305
Java	3, 883, 376	509, 627
Sumatra	8, 719, 070	1, 105, 471
	32, 118, 461	4, 307, 734
Persia: Masjid-i-Suleiman	43, 461, 000	5, 763, 000
Peru:		
La Brea and Parinas	9, 503, 722	1, 260, 553
Lobitos Restin	2, 413, 619	319, 310
Zorritos	89, 061	11, 689
	12, 006, 402	1, 591, 552
Poland:		
Drohobycz	4, 611, 444	623, 927
Jaslo	565, 702	76, 271
Stanislaw	315, 635	42, 798
	5, 492, 781	742, 996
Rumania:		
Bacau	505, 327	70, 321
Buzau	808, 324	112, 486
Dambovitza	7, 758, 106	1, 079, 614
Prahova	21, 701, 404	3, 019, 956
	30, 773, 161	4, 282, 377
Russia:[1] [2]		
Baku	55, 192, 534	7, 663, 501
Cheleken Island	54, 301	7, 755
Emba-Ural	1, 828, 197	252, 374
Ferghana	199, 697	28, 520
Grozny	26, 675, 681	3, 576, 308
Kuban-Black Sea	753, 955	105, 848
	84, 704, 365	11, 634, 306
Sakhalin: Okha	676, 903	105, 700
Venezuela:		
Northwest Venezuela—		
Maracaibo Basin—		
Ambrosio	2, 103, 812	303, 370
Benitez	1, 163, 239	165, 529
Buchivacoa [3]	26, 033	4, 001
Concepcion	1, 116	151
El Mene	1, 832, 420	239, 497
Lagunillas	61, 554, 219	9, 270, 065
La Paz	14, 436	2, 031
La Rosa	25, 118, 134	3, 689, 854
Mene Grande	13, 287, 704	1, 938, 676
Rio Oro and Rio Tarra	144, 733	20, 017
Other fields	121, 154	17, 313
Eastern Venezuela [3]—		
Guanoco	381, 536	60, 054
	105, 748, 536	15, 710, 558

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[1] Exclusive of Sakhalin, which is shown separately.

[2] Year ended Sept. 30

[3] A small output from eastern Venezuela is included under Buchivacoa.

IMPORTS AND EXPORTS

Imports of crude petroleum into the United States in 1928 amounted to 79,767,000 barrels, an increase of 37 per cent over 1927 and the largest quantity imported in any year since 1923. The imports in 1928 were valued at $90,473,000, a new high record in total value and an average of $1.13 per barrel. Imports of crude petroleum from Mexico again declined and those from Venezuela again increased, with the result that Venezuela displaced Mexico as the chief source of foreign oil. Imports from Venezuela in 1928 amounted to 46,977,000 barrels, or 59 per cent of the total. Imports from Peru decreased in 1928, but those from Colombia increased and focused attention further upon South America as a source of supply.

Receipts of foreign crude petroleum at Gulf ports again declined; those at Atlantic ports increased materially and amounted to 88 per cent of the total in 1928.

Exports of domestic and foreign crude petroleum from the United States in 1928, including a few thousand barrels shipped to the noncontiguous Territories, amounted to 18,966,000 barrels, an increase of 20 per cent over 1927. Canada was again the leading customer for crude oil, with receipts of 15,431,000 barrels, or 81 per cent of the total.

Crude petroleum imported, exported, and shipped to Territories, 1924–1928

[Barrels of 42 U. S. gallons]

Year	Imports		Exports (including foreign crude oil)		Shipments from United States to Territories						Total of exports and shipments to Territories
					Alaska		Hawaii		Porto Rico		
	Barrels	Value	Barrels	Value	Barrels	Value	Barrels	Value	Barrels	Value	Barrels
1924	77,775,173	$73,841,507	17,972,539	$26,660,412	204	$1,008	265,600	$275,600	179	$1,060	18,238,522
1925	61,824,242	75,406,956	13,335,107	24,369,277	124	232	1,429	7,200	-----	-------	13,336,660
1926	60,382,329	79,307,877	15,407,398	28,500,209	496	2,743	-------	-------	-----	-------	15,407,894
1927	58,382,632	78,609,117	15,843,646	25,944,822	-----	-------	-------	-------	-----	-------	15,843,646
1928	79,766,672	90,473,284	18,962,357	26,787,866	270	1,077	3,339	3,005	-----	-------	18,965,966

Crude petroleum imported and exported, 1927 and 1928, by months

[Thousands of barrels of 42 U. S. gallons]

	January	February	March	April	May	June	July	August	September	October	November	December	The year	
													Thousands of barrels	Value (thousands of dollars)
1927														
Imports:														
By countries—														
Colombia	839	585	856	591	625	180	542	381	764	797	727	1,075	7,962	13,559
Mexico	2,040	1,771	1,651	1,947	2,749	2,733	2,825	3,375	2,234	1,503	1,864	1,327	26,019	30,443
Peru	212	-----	421	338	120	120	48	240	288	-----	-----	100	1,887	4,157
Venezuela [1]	1,400	1,752	1,625	1,055	1,031	896	1,308	2,215	1,759	2,260	2,748	3,511	21,560	29,174
Other countries	102	73	29	132	32	90	100	50	77	73	-----	197	955	1,276
	4,593	4,181	4,582	4,063	4,557	4,019	4,823	6,261	5,122	4,633	5,339	6,210	58,383	78,609
By ports of entry—														
Atlantic coast	3,161	2,816	3,428	3,482	3,661	3,428	3,877	5,649	4,640	4,049	4,571	5,719	48,481	66,869
Gulf coast	1,432	1,365	1,154	581	890	586	937	612	482	584	768	491	9,882	11,694
Mexican border	-----	-----	-----	-----	-----	-----	3	-----	-----	-----	-----	-----	3	4
Northern border	-----	-----	-----	-----	6	5	6	-----	-----	-----	-----	-----	17	42
	4,593	4,181	4,582	4,063	4,557	4,019	4,823	6,261	5,122	4,633	5,339	6,210	58,383	78,609

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[1] Includes imports recorded by Bureau of Foreign and Domestic Commerce as from Netherland West Indies.

Crude petroleum imported and exported, 1927 and 1928, by months—Continued

													The year	
	January	February	March	April	May	June	July	August	September	October	November	December	Thousands of barrels	Value (thousands of dollars)
1927—Continued														
Exports:														
By countries—														
Domestic crude oil—														
Canada	968	884	1, 043	1, 020	1, 117	1, 191	894	1, 200	1, 038	1, 271	998	1, 412	13, 036	21, 579
Cuba	107	70	54	-----	54	-----	53	65	-----	71	53	-----	527	1, 303
Germany	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	64	94	158	262
Japan	125	164	69	119	117	164	138	82	247	74	127	208	1, 634	1, 906
Mexico	4	2	2	30	8	2	4	2	1	3	3	3	64	115
New Zealand	-----	-----	-----	-----	-----	6	-----	-----	11	79	-----	-----	96	114
Spain	-----	-----	29	-----	-----	48	-----	-----	-----	41	-----	-----	118	183
United Kingdom	-----	-----	-----	-----	69	-----	-----	-----	-----	-----	-----	-----	69	142
Other countries	-----	45	2	2	25	-----	-----	33	-----	-----	35	-----	142	341
Foreign crude oil	-----	-----	-----	-----	(2)	-----	-----	-----	-----	-----	-----	-----	(2)	(2)
	1, 204	1, 165	1, 199	1, 171	1, 390	1, 411	1, 089	1, 382	1, 297	1, 539	1, 280	1, 717	15, 844	25, 945
By ports—														
Atlantic coast	-----	45	3	-----	-----	-----	-----	-----	-----	-----	-----	-----	48	170
Gulf coast	107	70	83	30	214	48	131	98	169	313	131	133	1, 527	3, 019
Mexican border	3	2	1	2	2	1	3	2	1	3	3	79	102	138
Northern border	748	564	580	586	855	842	579	908	709	798	757	986	8, 912	16, 299
Pacific coast	346	484	532	553	319	520	376	374	418	425	389	519	5, 255	6, 319
	1, 204	1, 165	1, 199	1, 171	1, 390	1, 411	1, 089	1, 382	1, 297	1, 539	1, 280	1, 717	15, 844	25, 945
Excess of imports over exports	3, 389	3, 016	3, 383	2, 892	3, 167	2, 608	3, 734	4, 879	3, 825	3, 094	4, 059	4, 493	42, 539	52, 664
1928														
Imports:														
By countries—														
Colombia	1, 141	1, 499	1, 199	790	855	880	1, 271	807	1, 086	759	324	1, 227	11, 838	17, 210
Mexico	1, 465	963	1, 542	1, 204	1, 773	1, 704	1, 496	1, 366	1, 578	1, 240	1, 960	1, 293	17, 584	19, 400
Peru	271	-----	-----	157	-----	163	102	246	-----	120	165	-----	1, 224	2, 707
Venezuela [1]	3, 283	3, 574	3, 885	3, 397	4, 083	3, 727	4, 808	3, 601	4, 347	4, 227	3, 954	4, 091	46, 977	48, 644
Other countries	170	-----	219	113	55	79	201	121	128	357	505	196	2, 144	2, 512
	6, 330	6, 036	6, 845	5, 661	6, 766	6, 553	7, 878	6, 141	7, 139	6, 703	6, 908	6, 807	79, 767	90, 473
By ports of entry—														
Atlantic coast	5, 629	5, 671	6, 276	5, 273	6, 127	6, 253	7, 178	5, 174	5, 613	5, 613	5, 838	5, 769	70, 414	81, 443
Gulf coast	701	365	569	388	632	298	700	967	1, 511	1, 090	1, 065	1, 038	9, 324	8, 986
Mexican border	-----	-----	-----	-----	-----	-----	-----	-----	15	-----	-----	-----	15	17
Northern border	-----	-----	-----	-----	7	-----	-----	-----	-----	-----	5	-----	12	24
Pacific coast	-----	-----	-----	-----	-----	2	-----	-----	-----	-----	-----	-----	2	3
	6, 330	6, 036	6, 845	5, 661	6, 766	6, 553	7, 878	6, 141	7, 139	6, 703	6, 908	6, 807	79, 767	90, 473
Exports:														
By countries—														
Domestic crude oil—														
Canada	865	998	1, 298	931	1, 243	1, 463	1, 377	1, 724	1, 272	1, 632	1, 292	1, 336	15, 431	22, 235
Cuba	53	54	-----	145	-----	53	-----	53	53	54	63	-----	528	990
Germany	59	-----	-----	-----	-----	39	41	-----	-----	-----	-----	42	181	298
Japan	189	189	130	151	168	214	211	63	70	255	316	110	2, 066	2, 254
Mexico	26	2	27	50	27	27	1	2	2	3	4	4	175	171
New Zealand	-----	-----	-----	6	-----	-----	-----	-----	-----	-----	-----	-----	6	6
Spain	33	-----	44	-----	-----	-----	38	-----	34	-----	-----	37	186	278
United Kingdom	-----	-----	-----	-----	-----	-----	-----	22	-----	13	-----	-----	35	60
Other countries	-----	-----	30	20	55	83	1	19	71	58	16	-----	353	494
Foreign crude oil	-----	-----	1	-----	-----	-----	-----	-----	(3)	-----	-----	-----	1	2
	1, 225	1, 243	1, 530	1, 303	1, 493	1, 879	1, 669	1, 883	1, 502	2, 015	1, 691	1, 529	18, 962	26, 788
By ports—														
Atlantic coast	-----	-----	1	-----	-----	-----	116	13	-----	-----	-----	-----	130	207
Gulf coast	146	54	74	106	171	331	187	176	166	187	210	80	1, 888	3, 209
Mexican border	2	1	4	4	81	153	63	139	2	176	4	197	826	1, 026
Northern border	598	686	807	692	828	974	808	1, 186	839	1, 216	966	839	10, 439	16, 391
Pacific coast	479	502	644	501	413	421	495	369	495	436	511	413	5, 679	5, 955
	1, 225	1, 243	1, 530	1, 303	1, 493	1, 879	1, 669	1, 883	1, 502	2, 015	1, 691	1, 529	18, 962	26, 788
Excess of imports over exports	5, 105	4, 793	5, 315	4, 358	5, 273	4, 674	6, 209	4, 258	5, 637	4, 688	5, 217	5, 278	60, 805	63, 685

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[1] Includes imports recorded by Bureau of Foreign and Domestic Commerce as from Netherland West Indies.

[2] 241 barrels, valued at $333.

[3] Less than 500 barrels.

SHIPMENTS FROM CALIFORNIA THROUGH THE PANAMA CANAL

Shipments of crude oil from California through the Panama Canal to eastern ports in the United States, which have been declining, were reduced almost to the vanishing point in 1928, when only 2,301,000 barrels was transported in this trade as compared with 10,692,000 barrels in 1927. This material decrease resulted mainly from the increased competition offered by Venezuelan crude. Shipments of gasoline increased in 1928, but those of gas oil and fuel oil fell off materially.

California oil shipped through the Panama Canal to Atlantic and Gulf ports in the United States, 1927 and 1928, by months [1]

[Thousands of barrels of 42 U. S. gallons]

	January	February	March	April	May	June	July	August	September	October	November	December	The year
1927													
Crude oil	390	831	572	462	1, 341	1, 247	1, 124	1, 313	818	844	864	886	10, 692
Refined oils:													
Gasoline, naphtha, etc	749	1, 101	606	872	999	1, 043	1, 133	1, 268	1, 047	984	939	934	11, 675
Kerosene	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	74	74
Gas oil and Diesel oil	499	228	380	450	152	237	315	231	457	154	552	542	4, 197
Fuel oil	1, 072	1, 167	758	712	488	255	413	575	1, 060	363	75	72	7, 010
Lubricants	1	1	71	1	1	69	1	69	1	70	69	1	355
Asphalt	-----	1	1	1	1	1	2	1	4	2	2	1	17
Total refined	2, 321	2, 498	1, 816	2, 036	1, 641	1, 605	1, 864	2, 144	2, 569	1, 573	1, 637	1, 624	23, 328
Total crude and refined	2, 711	3, 329	2, 388	2, 498	2, 982	2, 852	2, 988	3, 457	3, 387	2, 417	2. 501	2, 510	34, 020
1928													
Crude oil	234	415	423	234	162	182	241	163	100	-----	147	-----	2, 301
Refined oils:													
Gasoline, naphtha, etc	1, 072	910	1, 150	1, 182	1, 386	1, 589	1, 745	1, 700	1, 269	1, 601	1, 288	1, 887	16, 779
Tops	-----	-----	-----	-----	76	-----	95	88	-----	80	-----	-----	339
Kerosene	-----	-----	-----	-----	-----	1	-----	-----	-----	-----	-----	-----	1
Gas oil and Diesel oil	312	93	257	170	251	-----	362	165	79	283	282	250	2, 504
Fuel oil	2	79	196	266	86	80	2	2	2	128	2	3	848
Lubricants	85	1	69	70	1	-----	1	5	24	4	73	2	335
Asphalt	1	2	6	1	1	2	1	3	3	4	3	2	29
Total refined	1, 472	1, 085	1, 678	1, 689	1, 801	1, 672	2, 206	1, 963	1, 377	2, 100	1, 648	2. 144	20, 835
Total crude and refined	1, 706	1, 500	2, 101	1, 923	1, 963	1, 854	2, 447	2, 126	1, 477	2, 100	1, 795	2, 144	23, 136

[1] Compiled by J. W. Mashaw and E. T. Knudsen, of the San Francisco office of the Bureau of Mines.

STOCKS

In this report stocks of crude petroleum are classified as follows:

1. Refinery stocks, or stocks held at refineries. These are reported separately for east of California only. Data concerning stocks held by other consumers are not available.

2. Pipe-line and tank-farm stocks, or petroleum that has been transported from the producing properties but has not been delivered at refineries or other points of consumption. For the States east of California such stocks are reported monthly as gross stocks, which include the total contents of tanks and pipe lines, and as net stocks, which are gross stocks minus sediment and water. The stocks reported for California were compiled by the San Francisco office of the Bureau of Mines and include all stocks of crude petroleum and fuel oil held on the Pacific coast, divided into two classes—light or refinable crude

(20° A. P. I. and above) and heavy crude (under 20° A. P. I.) and fuel oil.

3. Producers' stocks, or petroleum held at the wells on the producing properties. Producers' stocks are reported annually and during the past several years have amounted to between 5,000,000 and 10,000,000 barrels annually.

4. Stocks of foreign crude petroleum held by importers elsewhere than at refineries.

The consumption of domestic crude petroleum in the United States in 1928 was nearly 60,000,000 barrels greater than in 1927; the production of crude petroleum was virtually the same as in 1927. This, in the simplest terms, is the main reason the increase in crude stocks was less than 20,000,000 barrels in 1928, as compared with an accumulation of 70,000,000 barrels in 1927. (See fig. 34.) Total stocks of crude petroleum (including fuel oil in California) amounted to 490,788,000 barrels on December 31, 1928, as compared with 473,379,000 barrels on January 1, 1928, an increase of 17,409,000 barrels. This total increase was composed of an accumulation in refinery stocks of 1,212,000 barrels, in pipe-line and tank-farm stocks east of California of 14,928,000 barrels, in stocks of foreign crude petroleum held by importers of 175,000 barrels, and in heavy crude and fuel stocks in California of 5,200,000 barrels, and of a decrease in producers' stocks east of California of 1,015,000 barrels and in light crude stocks in California of 3,091,000 barrels. In general, stocks east of California increased rapidly during the first four months of the year—the period during which production in west Texas was steadily gaining. For the next four or five months the demand for crude by refiners was heavy and stocks registered a slow decline, followed by small increases late in the year. In California the demand for light or refinable crude exceeded the supply until the deep production at Santa Fe Springs made itself felt in December.

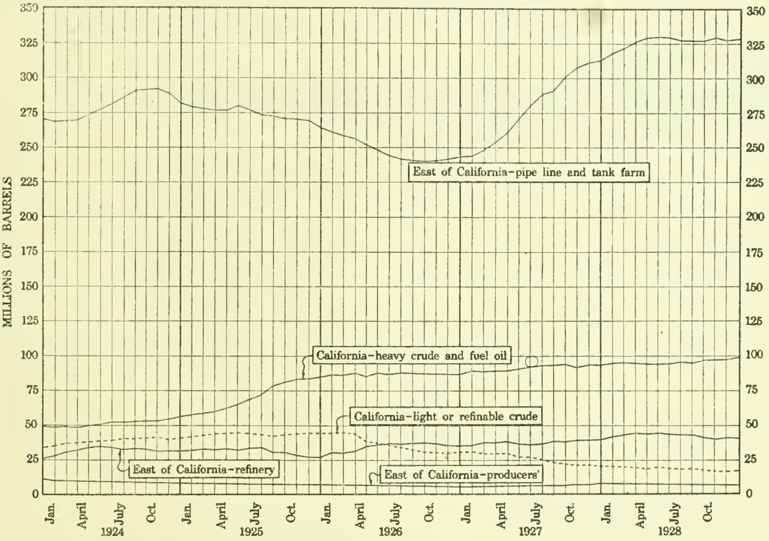

FIGURE 34.—Stocks of crude petroleum, 1924-1928, by months

Stocks of crude petroleum in the United States on December 31, 1924–1928

[Thousands of barrels of 42 U. S. gallons]

Year	Refinery stocks of crude petroleum	Pipe-line and tank-farm stocks of domestic crude petroleum, by fields of origin								Producers' stocks[2]	Foreign petroleum held by importers	Total
		Appalachian	Lima-Indiana	Illinois-southwest Indiana	Mid-Continent	Gulf coast	Rocky Mountain	California[1]	Total			
1924	40,995 [2] 31,184	9,286	1.221	10,870	210,558	20,200	28,672	68,867 [3] 96,505	349,674 [3] 377,312	8.389	734	399,792 [3] 417,619
1925	[2] 27,157 [4] 29,200	8,493	971	10,582	195,941	19,263	28,995	129,434 [5] 130,234	393,679 [5] 394,479	7,560	407	428,803 [4, 5] 431,646
1926	[2] 35,475	7,790	666	11,770	173,848	20,031	28,075	118,131 [6] 119,170	360,311 [6] 361,350	5,904	609	402,299 [6] 403,338
1927	[2] 39,317	7,334	1,134	12,170	246,839	17,922	27,238	113,805	426,442	7,536	84	473,379
1928	[2] 40,529	5,515	1,162	11,367	265,748	18,272	25,501	115,914	443,479	6,521	259	490,788

[1] Includes producers' stocks.
[2] Exclusive of California.
[3] California stocks reported on new basis to include total stocks of crude petroleum and fuel oil.
[4] Includes 2,043,000 barrels in coastwise transit—for comparison with 1926 figures.
[5] Includes 800,000 barrels working stocks not previously recorded.
[6] Figures for comparison with 1927 and 1928.

Stocks of crude petroleum held in the United States at end of each month, 1927 and 1928

[Thousands of barrels of 42 U. S. gallons]

		January	February	March	April	May	June	July	August	September	October	November	December
1927													
East of California:													
At refineries, by location of storage—													
East coast—													
Domestic		7, 426	7, 942	7, 230	8, 134	7, 754	8, 720	8, 999	9, 401	9, 062	8, 772	8, 045	8, 690
Foreign		2, 164	2, 604	2, 206	2, 782	3, 043	2, 909	2, 671	3, 029	2, 986	2, 675	2, 980	2, 768
Appalachian		1, 597	1, 606	1, 627	1, 648	1, 662	1, 668	1, 785	1, 783	1, 768	1, 740	1, 822	1, 871
Indiana, Illinois, Kentucky, etc		2, 284	2, 491	2, 561	2, 545	2, 465	2, 507	2, 561	2, 746	2, 727	2, 737	2, 692	2, 777
Oklahoma, Kansas, and Missouri		3, 135	3, 551	3, 841	3, 922	4, 301	4, 413	4, 428	4, 400	4, 536	4, 850	4, 924	4, 871
Texas—													
Inland		1, 094	1, 120	1, 197	1, 173	1, 196	1, 304	1, 450	1, 463	1, 621	1, 677	1, 656	1, 432
Gulf coast—													
Domestic		8, 133	8, 305	8, 481	8, 220	8, 307	6, 961	6, 657	6, 758	7, 295	7, 473	7, 653	7, 686
Foreign		152	237	257	323	304	242	226	203	204	174	204	219
Arkansas and inland Louisiana		553	560	441	408	420	431	454	448	355	402	457	408
Louisiana, Gulf coast—													
Domestic		6, 787	7, 179	7, 317	6, 788	4, 793	4, 037	4, 559	5, 126	5, 130	5, 643	6, 104	6, 149
Foreign		722	967	889	832	1, 072	1, 282	1, 373	1, 288	1, 083	1, 043	1, 150	1, 046
Rocky Mountain		1, 608	1, 504	1, 385	1, 380	1, 181	1, 293	1, 382	1, 385	1, 446	1, 368	1, 394	1, 400
Total at refineries		35, 655	38, 066	37, 432	38, 155	36, 498	35, 767	36, 545	38, 030	38, 213	38, 554	39, 081	39, 317
Pipe-line and tank-farm stocks—													
Domestic petroleum, by fields of origin—													
Appalachian—													
New York, Pennsylvania, West Virginia, eastern and central Ohio	Gross	6, 607	6, 676	6, 724	6, 879	6, 976	7, 046	7, 156	7, 216	7, 051	6, 859	6, 795	6, 621
	Net	6, 321	6, 392	6, 441	6, 597	6, 693	6, 772	6, 883	6, 946	6, 726	6, 541	6, 499	6, 294
Kentucky	Gross	1, 243	1, 244	1, 276	1, 333	1, 413	1, 404	1, 324	1, 302	1, 269	1, 207	1, 216	1, 168
	Net	1, 118	1, 119	1, 151	1, 212	1, 288	1, 279	1, 199	1, 176	1, 139	1, 080	1, 090	1, 040
Lima-Indiana	Gross	879	877	907	942	983	1, 019	1, 098	1, 106	1, 159	1, 230	1, 263	1, 287
	Net	667	666	695	731	771	820	899	946	1, 006	1, 077	1, 109	1, 134
Illinois-southwestern Indiana	Gross	12, 372	12, 293	12, 295	12, 247	12, 214	12, 198	12, 669	12, 676	12, 639	12, 626	12, 708	12, 664
	Net	11, 887	11, 808	11, 810	11, 762	11, 729	11, 712	12, 184	12, 184	12, 113	12, 100	12, 189	12, 170
Mid-Continent—													
Oklahoma, Kansas, north, central, western, and Panhandle Texas	Gross	159, 699	165, 789	171, 372	179, 064	188, 505	196, 728	205, 042	213, 200	219, 649	226, 639	230, 466	234, 420
	Net	147, 146	153, 462	159, 666	167, 024	176, 398	184, 865	193, 217	201, 313	207, 592	214, 803	219, 130	221, 466
North Louisiana and Arkansas	Gross	32, 825	31, 572	31, 347	31, 098	30, 460	30, 906	31, 357	29, 929	29, 393	28, 107	28, 021	28, 174
	Net	30, 182	29, 074	28, 473	27, 603	27, 793	28, 193	27, 791	27, 199	26, 641	25, 546	25, 594	25, 373
Gulf coast	Gross	18, 608	18, 186	18, 511	18, 653	18, 774	18, 937	18, 395	18, 424	18, 661	18, 662	18, 653	18, 365
	Net	18, 283	17, 832	18, 159	18, 285	18, 397	18, 558	17, 985	17, 945	18, 223	18, 244	18, 265	17, 922
Rocky Mountain	Gross	27, 584	27, 387	26, 956	27, 056	27, 165	27, 257	27, 434	27, 478	27, 647	27, 716	27, 298	27, 281
	Net	27, 532	27, 289	26, 904	27, 002	27, 114	27, 203	27, 377	27, 415	27, 599	27, 670	27, 256	27, 238
Total pipe-line and tank-farm	Gross	259, 817	264, 024	269, 388	277, 277	286, 490	295, 495	304, 475	311, 331	317, 468	323, 046	326, 420	329, 980
	Net	243, 136	247, 642	253, 299	260, 216	270, 183	279, 402	287, 535	295, 124	301, 039	307, 061	311, 132	312, 637

Stocks of crude petroleum held in the United States at end of each month, 1927 and 1928—Continued

[Thousands of barrels of 42 U. S. gallons]

	January	February	March	April	May	June	July	August	September	October	November	December
1927—Continued												
East of California—Continued.												
Pipe-line and tank-farm stocks—Continued.												
Foreign crude petroleum held in United States by importers—												
At Atlantic coast stations	84	108	70	109	80	58	42	39	37	51	41	46
At Gulf coast stations	427	450	341	339	206	237	256	220	183	198	233	38
Total	511	558	411	448	286	295	298	259	220	249	274	84
Producers' stocks [1]	5,934	5,967	6,001	6,040	6,073	6,112	6,229	6,473	6,813	7,066	7,256	7,536
Total crude stocks east of California	285,236	292,233	297,143	304,859	313,040	321,576	330,607	339,886	346,285	352,930	357,743	359,574
California	120,060	118,604	118,671	118,997	118,550	118,862	118,312	116,615	116,646	113,909	115,153	113,805
Total	405,296	410,837	415,814	423,856	431,590	440,438	448,919	456,501	462,931	466,839	472,896	473,379
Classification by gravity:												
East of California [2]—												
Light crude (24° and above)	230,976	238,529	245,405	252,584	259,020	267,610	276,871	286,803	290,851	297,336	301,325	303,539
Heavy crude (below 24°)	48,326	47,737	45,737	46,235	47,947	47,854	47,507	46,610	48,621	48,528	49,162	48,499
California—												
Light crude (20° and above)	31,017	29,770	29,568	29,460	27,143	26,898	25,301	23,262	22,826	21,676	21,273	20,086
Heavy crude (below 20° and including fuel oil)	89,043	88,834	89,103	89,537	91,407	91,964	93,011	93,353	93,820	92,233	93,880	93,719
1928												
East of California:												
At refineries, by location of storage—												
East coast—												
Domestic	8,469	8,463	8,706	7,979	7,778	8,409	8,698	9,154	8,053	8,235	8,243	8,496
Foreign	4,004	4,323	5,414	5,866	6,140	5,862	5,349	4,946	3,964	3,686	3,773	4,306
Appalachian	1,883	1,956	2,060	2,166	2,266	2,242	2,186	2,258	2,185	2,131	2,235	2,183
Indiana, Illinois, Kentucky, etc	2,812	2,904	3,015	3,148	3,097	2,957	3,053	2,891	2,759	2,931	2,982	2,939
Oklahoma, Kansas, and Missouri	5,655	5,888	5,759	5,889	6,193	5,662	5,688	5,208	5,247	5,329	5,849	5,530
Texas—												
Inland	1,484	1,554	1,665	1,558	1,790	1,927	1,863	1,926	1,767	1,712	1,885	2,184
Gulf coast—												
Domestic	8,006	7,996	7,868	8,132	8,110	8,469	8,152	7,814	8,189	7,663	7,399	7,206
Foreign	153	263	383	243	111	102	150	54	128	158	179	207
Arkansas and inland Louisiana	441	578	654	684	797	881	840	882	852	936	1,098	758
Louisiana, Gulf coast—												
Domestic	5,886	6,063	5,859	5,343	4,722	4,149	4,462	4,690	4,656	4,220	3,954	3,315
Foreign	1,289	1,230	1,080	1,053	979	970	1,194	1,049	1,117	1,031	1,153	1,359

Rocky Mountain		1,498	1,610	1,655	1,541	1,430	1,488	1,440	1,545	1,680	1,774	2,017	2,046
Total at refineries		41,580	42,828	44,118	43,602	43,413	43,118	43,075	42,417	40,597	39,806	40,767	40,529
Pipe-line and tank-farm stocks—													
Domestic petroleum, by fields of origin—													
Appalachian—													
New York, Pennsylvania, West Virginia, eastern and central Ohio	Gross	6,471	6,551	6,490	6,269	6,285	6,365	6,202	5,960	5,689	5,573	5,318	5,036
	Net	6,160	6,240	6,181	5,959	5,977	6,068	5,910	5,657	5,375	5,270	5,023	4,751
Kentucky	Gross	1,176	1,191	1,249	1,337	1,335	1,230	1,267	1,158	999	986	961	913
	Net	1,048	1,063	1,121	1,208	1,200	1,097	1,139	1,040	845	834	810	764
Lima-Indiana	Gross	1,282	1,306	1,390	1,377	1,415	1,447	1,513	1,528	1,529	1,517	1,397	1,344
	Net	1,128	1,153	1,210	1,196	1,234	1,267	1,333	1,348	1,346	1,335	1,214	1,162
Illinois-southwestern Indiana	Gross	12,616	12,534	12,711	12,720	12,776	12,702	12,551	12,570	12,195	12,107	11,927	12,035
	Net	12,122	12,039	12,208	12,217	12,273	12,200	12,049	11,909	11,527	11,440	11,260	11,367
Mid-Continent—													
Oklahoma, Kansas, north, central, western, and Panhandle Texas	Gross	238,229	242,263	247,448	250,252	250,543	249,610	247,487	248,109	248,361	250,331	250,505	251,849
	Net	225,964	229,736	234,613	237,530	237,727	236,770	235,087	235,597	236,105	238,241	238,581	239,345
North Louisiana and Arkansas	Gross	28,455	28,645	28,775	29,024	28,984	29,711	29,816	29,284	28,894	29,037	28,402	29,131
	Net	25,837	26,131	25,735	26,286	26,358	26,747	26,621	26,176	26,125	26,072	25,638	26,403
Gulf coast	Gross	18,550	17,853	17,192	17,073	17,015	17,527	17,689	18,304	18,795	19,237	18,826	18,826
	Net	18,161	17,458	16,818	16,669	16,596	17,030	17,235	17,813	18,308	18,753	18,373	18,272
Rocky Mountain	Gross	27,324	27,198	27,358	27,334	27,174	27,075	26,984	26,702	26,333	26,031	25,747	25,522
	Net	27,280	27,154	27,315	27,291	27,130	27,036	26,943	26,665	26,295	25,991	25,714	25,501
Total pipe-line and tank-farm	Gross	334,103	337,541	342,613	345,386	345,527	345,667	343,509	343,615	342,795	344,819	343,083	344,656
	Net	317,700	320,974	325,201	328,356	328,495	328,215	326,317	326,205	325,926	327,936	326,613	327,565
Foreign crude petroleum held in United States by importers—													
At Atlantic coast stations		40	43	75	65	58	91	40	23	43	52	67	49
At Gulf coast stations		43	14	45	54	51	51	42	62	154	155	175	210
Total		83	57	120	119	109	142	82	85	197	207	242	259
Producers' stocks [1]		7,450	7,370	7,284	7,201	7,115	7,032	6,946	6,860	6,777	6,691	6,608	6,521
Total crude stocks east of California		366,813	371,229	376,723	379,278	379,132	378,507	376,420	375,567	373,497	374,640	374,230	374,874
California		114,899	114,970	114,095	113,141	113,341	113,431	113,878	113,367	113,433	113,709	113,963	115,914
Total		481,712	486,199	490,818	492,419	492,473	491,938	490,298	488,934	486,930	488,349	488,193	490,788
Classification by gravity:													
East of California [2]—													
Light crude (24° and above)		309,475	313,137	318,261	319,770	320,429	319,585	318,087	317,538	317,203	319,221	319,199	319,928
Heavy crude (below 24°)		49,888	50,722	51,178	52,307	51,588	51,890	51,387	51,169	49,517	48,728	48,423	48,425
California—													
Light crude (20° and above)		20,562	20,142	19,579	18,782	19,470	19,197	18,215	18,310	16,870	16,684	16,524	16,995
Heavy crude (below 20° and including fuel oil)		94,337	94,828	94,516	94,359	93,871	94,234	95,663	95,057	96,563	97,025	97,439	98,919

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[1] Figures for December based on reports from companies; other months prorated.

[2] Exclusive of producers' stocks.

CONSUMPTION

The consumption of crude petroleum, as measured by runs to stills at refineries, continued to increase rapidly in 1928, when a total of 913,295,000 barrels was processed. Of this amount 835,711,000 barrels was domestic crude petroleum and 77,584,000 barrels was foreign crude petroleum. The figure for domestic crude in 1928 represents an increase of 7 per cent over 1927 and that for foreign crude petroleum an increase of 55 per cent. Notwithstanding the rapid increase in domestic production in recent years 1928 is the third successive year in which the percentage increase in use of foreign crude has exceeded the increase in use of domestic crude. The rapid growth in consumption of foreign crude is emphasized further by the fact that the demand for domestic crude on the Atlantic seaboard, where nearly all of the foreign crude is processed, decreased in 1928. The chief factor in the increased throughput of crude petroleum at refineries in 1928 was the comparable increase in capacity. The number of plants in operation increased steadily with the approach of the heavy summer demand for gasoline and following the completion of new refineries in west Texas. The total capacity of the older plants was raised materially through the installation of new equipment. Daily average crude runs to stills increased steadily beginning with February and reached a peak of 2,663,000 barrels in September. (See fig. 35.) The daily average in December amounted to 2,565,000 barrels, which, although about 100,000 barrels below the September peak, was 12 per cent above the average in December, 1927. All of the 10 major refining districts recorded increases in the quantity of crude run to stills in 1928, with the largest percentage gains in the Indiana-Illinois-Kentucky, the inland Texas, and the Appalachian districts and the smallest in the Rocky Mountain and the California districts.

The domestic consumption of all oils, as given in the table on pages 620 and 621, amounted to 860,935,000 barrels, an increase of 7 per cent over 1927. In addition to this consumption a total of 154,449,000 barrels of oil (crude and refined) was shipped out of the country, which, added to the domestic demand, gives a total demand of 1,015,384,000 barrels, an increase of 8 per cent over 1927.

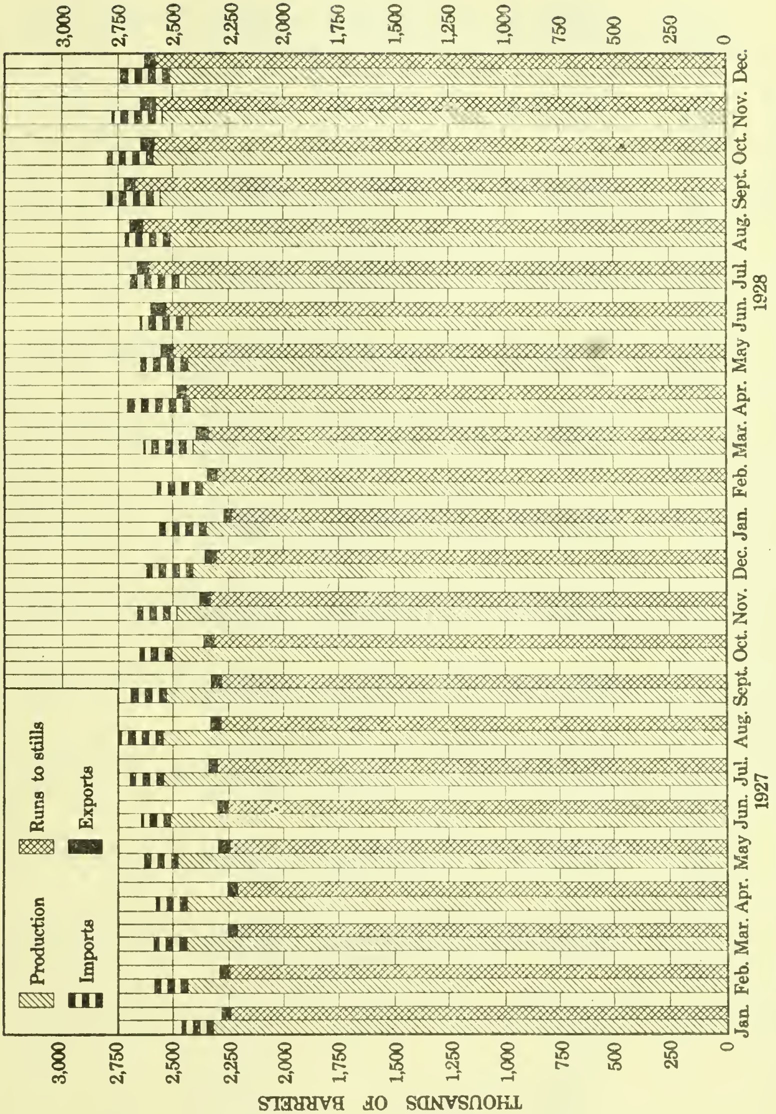

FIGURE 35.—Daily average production, imports, runs to stills, and exports of crude petroleum, 1927 and 1928, by months

Crude petroleum run to stills at refineries in the United States, 1927 and 1928, by districts and months

[Thousands of barrels of 42 U. S. gallons]

	January	February	March	April	May	June	July	August	September	October	November	December	The year
1927													
East coast:													
Domestic	9,049	7,877	9,223	8,625	9,295	9,095	9,296	9,494	9,032	9,235	9,127	9,164	108,512
Foreign	2,499	2,326	2,968	2,823	2,776	3,020	3,222	3,888	3,817	4,670	4,756	5,282	42,047
Appalachian	2,367	2,278	2,406	2,358	2,401	2,407	2,384	2,477	2,449	2,650	2,365	2,399	28,941
Indiana, Illinois, Kentucky, etc	5,931	5,096	5,905	5,571	6,521	6,629	7,068	6,656	6,133	6,504	6,716	7,077	75,807
Oklahoma, Kansas, and Missouri	7,973	7,655	8,062	8,033	8,398	8,457	9,227	9,251	9,133	8,856	8,342	8,484	101,871
Texas:													
Inland	3,052	2,874	3,080	2,943	3,026	3,183	3,271	3,070	2,962	3,145	3,298	3,188	37,092
Gulf coast—													
Domestic	11,460	10,001	10,825	10,339	11,152	10,343	10,859	10,514	10,047	11,498	11,027	11,124	129,189
Foreign	120	58	85	100	109	96	51	24	23	43	21	84	814
Arkansas and inland Louisiana	1,799	1,718	1,768	1,699	1,779	1,710	1,653	1,704	1,630	1,517	1,473	1,581	20,031
Louisiana, Gulf coast:													
Domestic	3,846	3,458	4,014	4,021	3,627	3,259	3,391	3,380	3,559	3,720	3,384	3,509	43,168
Foreign	1,032	765	734	466	549	522	562	591	549	525	456	494	7,245
Rocky Mountain	2,469	2,278	2,441	2,336	1,903	1,998	2,139	1,907	1,638	1,866	2,030	2,021	25,026
California	17,931	16,577	17,161	17,179	18,164	16,848	18,282	18,001	17,560	17,532	16,993	16,864	209,092
	69,528	62,961	68,672	66,493	69,700	67,567	71,405	70,957	68,532	71,761	69,988	71,271	828,835
1928													
East coast:													
Domestic	8,893	8,293	8,302	8,300	8,569	8,288	8,837	9,104	8,587	8,397	7,818	8,332	101,720
Foreign	4,648	4,764	5,284	5,355	5,937	6,686	6,572	5,901	6,078	5,940	5,757	5,864	68,786
Appalachian	2,445	2,367	2,593	2,644	2,827	2,885	2,998	3,048	3,071	2,994	2,841	2,930	33,643
Indiana, Illinois, Kentucky, etc	7,077	6,717	7,710	7,488	8,426	8,536	8,832	9,209	9,011	8,765	8,632	8,502	98,905
Oklahoma, Kansas, and Missouri	8,294	7,870	8,726	8,880	9,581	9,228	9,789	10,329	10,103	9,984	9,189	9,369	111,342
Texas:													
Inland	3,061	3,042	3,549	3,567	3,895	3,757	4,622	4,864	4,434	4,614	4,328	4,363	48,096
Gulf coast—													
Domestic	10,982	10,658	11,291	11,618	11,720	10,722	11,766	11,883	11,170	11,131	11,857	11,936	136,734
Foreign	53	67	56	70	117	70	94	97	87	297	129	109	1,246
Arkansas and inland Louisiana	1,475	1,489	1,696	1,740	2,031	1,783	2,003	2,073	2,135	2,087	2,067	2,096	22,675
Louisiana, Gulf coast:													
Domestic	3,744	3,242	3,590	3,859	4,210	3,770	3,600	3,412	3,901	3,920	3,992	4,073	45,313
Foreign	321	457	392	414	560	490	503	992	944	1,161	670	648	7,552
Rocky Mountain	1,978	1,844	2,046	2,140	2,369	2,180	2,314	2,315	2,279	2,282	2,161	2,153	26,061
California	16,190	15,838	17,386	17,009	17,172	17,563	18,672	18,354	18,094	18,091	17,708	19,145	211,222
	69,161	66,648	72,621	73,084	77,414	75,958	80,602	81,581	79,894	79,663	77,119	79,520	913,295

Indicated deliveries of crude petroleum (exclusive of California grades) to domestic consumers, 1927 and 1928, by months [1]

[Thousands of barrels of 42 U. S. gallons]

	January	February	March	April	May	June	July	August	September	October	November	December	The year
1927													
Domestic petroleum, by fields of origin:													
Appalachian	2, 681	2, 246	2, 595	2, 322	2, 441	2, 534	2, 517	2, 653	2, 843	2, 837	2, 561	2, 685	30, 915
Lima-Indiana	139	157	141	120	121	122	77	111	93	82	99	104	1, 366
Michigan	29	29	38	40	39	41	37	40	38	38	33	33	435
Illinois and southwestern Indiana	527	696	751	637	693	679	164	672	711	635	537	615	7, 317
Mid-Continent	37, 396	35, 089	39, 073	36, 654	36, 976	36, 707	40, 846	41, 359	40, 812	41, 645	41, 696	43, 688	471, 941
Gulf coast	6, 605	4, 674	4, 279	4, 265	4, 438	4, 290	4, 900	4, 296	3, 901	4, 262	4, 016	4, 553	54, 479
Rocky Mountain [2]	3, 203	2, 702	3, 102	2, 637	2, 623	2. 484	2, 603	2, 477	2, 125	2, 243	2, 709	2, 483	31, 391
Deliveries and exports	50, 580	45, 593	49, 979	46, 675	47, 331	46, 857	51, 144	51, 608	50, 523	51, 742	51, 651	54, 161	597, 844
Exports	858	681	667	618	1, 071	890	713	1, 008	879	1, 114	890	1, 198	10, 587
Deliveries	49, 722	44, 912	49, 312	46, 057	46, 260	45, 967	50, 431	50, 600	49, 644	50, 628	50, 761	52, 963	587, 257
Foreign petroleum	4, 691	4, 134	4, 729	4, 026	4, 719	4, 010	4, 820	6, 300	5, 161	4, 604	5, 314	6, 400	58, 908
	54, 413	49, 046	54, 041	50, 083	50, 979	49, 977	55, 251	56, 900	54, 805	55, 232	56, 075	59, 363	646, 165
1928													
Domestic petroleum, by fields of origin:													
Appalachian	2, 530	2, 321	2, 650	2, 650	2, 755	2, 583	2, 785	3, 076	2, 952	2, 895	2, 826	2, 885	32, 908
Lima-Indiana	130	107	88	152	125	125	93	130	132	153	238	176	1, 649
Michigan	31	30	29	37	47	50	56	46	37	73	88	71	595
Illinois and southwestern Indiana	629	674	538	534	599	701	784	799	970	733	775	496	8, 232
Mid-Continent	39, 660	37, 818	41, 205	41, 493	45, 512	44, 238	47, 578	48, 003	47, 691	48, 104	46, 870	46, 779	534, 951
Gulf coast	3, 486	4, 032	4. 373	3, 788	4, 156	3, 606	3, 958	3, 580	3, 355	3, 586	4, 235	4, 176	46, 331
Rocky Mountain [2]	2, 381	2, 323	2, 422	2, 375	2, 722	2, 541	2, 577	2, 872	2, 804	2, 902	2, 641	2, 524	31, 084
Deliveries and exports	48, 847	47, 305	51, 305	51, 029	55, 916	53, 844	57, 831	58, 506	57, 941	58, 446	57, 673	57, 107	655, 750
Exports	745	741	886	802	1, 081	1, 458	1, 174	1, 515	1, 007	1, 579	1, 181	1, 115	13, 284
Deliveries	48, 102	46, 564	50, 419	50, 227	54, 835	52, 386	56, 657	56, 991	56, 934	56, 867	56, 492	55, 992	642, 466
Foreign petroleum	6, 331	6, 062	6, 781	5, 662	6, 776	6, 520	7, 938	6, 138	7, 027	6, 693	6, 873	6, 790	79, 591
	54, 433	52, 626	57, 200	55, 889	61, 611	58, 906	64, 595	63, 129	63, 961	63, 560	63, 365	62, 782	722, 057

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[1] Indicated deliveries equal production plus imports plus stocks, exclusive of refinery stocks, at beginning of period minus exports and stocks at end of period.

[2] Includes Alaska.

PRICES AND VALUES

The total value of the crude petroleum produced in the United States in 1928 amounted to $1,054,880,000, an average of $1.17 per barrel. This average represents the lowest value per barrel since 1916, when the influence of Cushing had begun to wane. With the exception of the States comprising the Appalachian district and of Montana, all the States showed a lower average per barrel in 1928 than in 1927. The rise in average price in Montana from $1.40 in 1927 to $1.59 in 1928 was a reflection of the growing demand for crude by small refiners in the Kevin-Sunburst area. Although the 1928 average value of $1.17 represents a decline of $0.13 per barrel from the 1927 average, prices were in reality firmer in 1928 than during 1927; in fact, in a few fields, particularly the eastern fields, material increases in prices occurred. The demand for crude in the Appalachian area was particularly strong, and prices were repeatedly advanced; for example, the price of Pennsylvania-grade crude (in lines of the National Transit Co.) advanced from $2.65 per barrel on January 1 to $3.75 before the end of the year. The lower-price grades from the Eastern States were, almost without exception, raised in price at some time in the latter half of the year, but these advances were not so well marked as that cited above for Pennsylvania-grade crude. In the latter part of July the price of Oklahoma-Kansas and north Texas crudes was raised (see fig. 36), the increase varying with the gravity but averaging 10 cents or slightly more. This increase, the only one of consequence in 1928, was hailed enthusiastically by the industry as marking the turning point from a period of abnormally low prices. The posted price of west Texas crude ranged during the year between 60 and 65 cents, but new contract prices were reported to have been somewhat in excess of these figures,

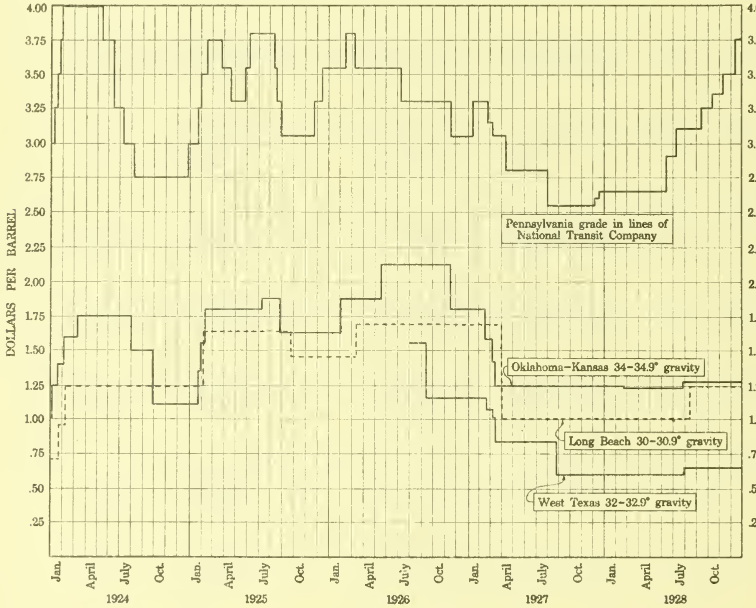

FIGURE 36.—Posted prices of selected grades of crude petroleum, 1924-1928

a reflection of the success of proration and of the growing demand from refiners. The posted prices of Gulf coast crude were unchanged throughout the year. The movement of posted prices in the majority of the Rocky Mountain fields was in sympathy with that in the Mid-Continent. Only one price change occurred in California in 1928. This took place on August 15 and raised refinable grades of crude an average of about 25 cents. The price of heavy crude in California remained weak and unchanged at either $0.75 or $0.80 per barrel throughout the year.

Average price per barrel paid for crude petroleum at the wells, 1924–1928, by States

[Based on actual purchases, including premiums]

State	1924	1925	1926	1927	1928
Alaska	(1)	$4.25	(1)	(1)	(1)
Arkansas	$0.94	.89	$1.11	$1.06	$0.86
California [2]	1.20	1.42	1.54	1.13	.99
Colorado	1.10	1.48	1.84	1.20	.99
Illinois	1.76	1.94	2.22	1.67	1.54
Indiana:					
Southwestern	1.80	1.92	2.22	1.65	1.53
Northeastern	1.93	2.06	2.07	1.51	1.24
Total Indiana	1.84	1.95	2.19	1.63	1.50
Kansas	1.54	1.94	2.26	1.42	1.36
Kentucky	1.97	2.32	2.43	1.67	1.61
Louisiana:					
Gulf coast	1.63	1.57	1.39	1.21	1.16
Northern	1.41	1.61	1.70	1.33	1.20
Total Louisiana	1.44	1.60	1.65	1.30	1.18
Michigan	------	2.50	2.69	1.90	1.55
Montana	1.33	1.57	1.32	1.40	1.59
New Mexico	1.30	1.71	1.96	1.37	1.36
New York	3.64	3.70	3.68	3.17	3.36
Ohio:					
Central and eastern	$2.74	$2.67	$2.74	$2.02	$2.20
Northwestern	2.00	2.17	2.34	1.80	1.59
Total Ohio	2.52	2.53	2.64	1.97	2.06
Oklahoma	1.57	1.97	2.31	1.43	1.39
Pennsylvania	3.61	3.62	3.56	3.06	3.27
Tennessee	1.80	2.21	2.33	1.50	1.52
Texas:					
Gulf coast	1.56	1.62	1.50	1.30	1.19
Rest of State	1.51	1.86	1.96	1.10	.87
Total Texas	1.52	1.81	1.85	1.14	.92
Utah	(1)	1.00	(1)	(1)	(1)
West Virginia	3.52	3.48	3.46	2.89	3.03
Wyoming	1.23	1.76	1.98	1.40	1.28
Other	[3]3.38	------	[3]1.25	[3]4.71	[3]5.00
United States	1.43	1.68	1.88	1.30	1.17

[1] Included under "Other."
[2] Division of Mines and Mining, Department of Natural Resources, California.
[3] Alaska and Utah.

Average monthly prices per barrel for selected grades of crude petroleum at wells, 1927 and 1928

	Pennsylvania	Oklahoma-Kansas (38°–38.9°)	Gulf Coast Grade A	Illinois	Lima, Ohio	Panhandle (Carson and Hutchinson Counties 35°–35.9°)	California (Long Beach 30°–30.9°)
1927							
January	$3.20	$2.00	$1.40	$2.10	$2.21	$1.25	$1.70
February	3.27	1.94	1.40	2.06	2.17	1.25	1.70
March	3.07	1.42	1.26	1.69	1.80	1.03	1.70
April	2.90	1.32	1.20	1.60	1.71	.95	1.00
May	2.80	1.32	1.20	1.60	1.71	.95	1.00
June	2.80	1.32	1.20	1.60	1.71	.95	1.00
July	2.80	1.32	1.20	1.60	1.71	.95	1.00
August	2.55	1.32	1.20	1.60	1.71	.89	1.00
September	2.55	1.32	1.20	1.60	1.71	.75	1.00
October	2.55	1.32	1.20	1.60	1.71	.75	1.00
November	2.55	1.32	1.20	1.60	1.71	.75	1.00
December	2.62	1.32	1.20	1.60	1.71	.75	1.00
	2.80	1.43	1.24	1.68	1.79	.93	1.17
1928							
January	2.65	1.32	1.20	1.60	1.71	.75	1.00
February	2.65	1.33	1.20	1.58	1.60	.76	1.00
March	2.65	1.34	1.20	1.50	1.55	.79	1.00
April	2.65	1.34	1.20	1.50	1.55	.79	1.00
May	2.65	1.34	1.20	1.50	1.55	.79	1.00
June	2.80	1.34	1.20	1.50	1.55	.79	1.00
July	3.05	1.36	1.20	1.51	1.56	.81	1.00
August	3.10	1.46	1.20	1.55	1.60	.91	1.14
September	3.19	1.46	1.20	1.55	1.60	.91	1.25
October	3.31	1.46	1.20	1.55	1.60	.91	1.25
November	3.46	1.46	1.20	1.55	1.60	.91	1.25
December	3.65	1.46	1.20	1.55	1.60	.91	1.25
	2.98	1.39	1.20	1.54	1.59	.84	1.09

Posted price per barrel of petroleum at wells in 1928, by grades, with dates of change

Date	Appalachian field [1]												Lima-Indiana field [2]		Illinois and southwestern Indiana field [2]		
	Pennsylvania grade in lines of New York Transit Co. and Bradford grade in lines of National Transit Co.	Pennsylvania grade															
		In lines of Southwest Pennsylvania Pipe Line Co. and National Transit Co.	In lines of Eureka Pipe Line Co.	In lines of Buckeye Pipe Line Co.	Keister grade in lines of National Transit Co.	Cabell grade in lines of Eureka Pipe Line Co.	Corning grade in lines of Buckeye Pipe Line Co.[3]	Wooster [2]	Ragland	Somerset oil in lines of Cumberland Pipe Line Co.	Western Kentucky [2]	Tennessee [4]	Lima, Ohio	Indiana	Illinois and Princeton, Ind.	Plymouth	Waterloo
Jan. 1	$2.80	$2.65	$2.60	$2.35	$1.10	$1.50	$1.45	$1.57	$0.95	$1.60	$1.33	$1.50	$1.71	$1.48	$1.60	$1.33	$1.35
Feb. 9						1.35	1.55			1.45							
Feb. 10													1.55	1.32			
Feb. 23															1.50	1.23	
June 13	3.05	2.90	2.85	2.65	1.20	1.45				1.55							
June 29							1.70										
July 9	3.20	3.10	3.00	2.85													
July 18											1.48						
July 20												1.55					
July 27								1.67					1.60	1.37	1.55	1.28	
July 30										1.70							
Aug. 8							1.80										
Sept. 1												1.65					
Sept. 14	3.35	3.25	3.15	3.00						1.75							
Sept. 17											1.63						
Oct. 1												1.75					
Oct. 13	3.45	3.35	3.25	3.10	(5)												
Oct. 17								1.77									
Nov. 9	3.60	3.50	3.40	3.25													
Dec. 14	3.85	3.75	3.65	3.60													
Dec. 17							1.90										
Average for year	3.11	2.98	2.91	2.72		1.42	1.66	1.63	.95	1.60	1.44	1.58	1.59	1.36	1.54	1.27	1.35

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[1] The Joseph Seep Purchasing Agency.
[2] The Ohio Oil Co.
[3] Corning crude run prior to Sept. 15, 1926, posted at 10 cents less.
[4] Paragon Development Co.
[5] Discontinued.

Date	Michigan																						
	Sagi-naw sand[1]	Berea sand[1]	Muskegon[2]																				
			32°–32.9°	33°–33.9°	34°–34.9°	35°–35.9°	36°–36.9°	37°–37.9°	38°–38.9°	39°–39.9°	40°–40.9°	41°–41.9°	42°–42.9°	43°–43.9°	44°–44.9°	45°–45.9°	46°–46.9°	47°–47.9°	48°–48.9°	49°–49.9°	50°–50.9°	51°–51.9°	52° and above
Jan. 1	$2.05	$1.95	$1.20	$1.22	$1.24	$1.26	$1.28	$1.30	$1.32	$1.34	$1.36	$1.38	$1.40	$1.42	$1.44	$1.46	$1.48	$1.50	$1.52	$1.54	$1.56	$1.58	$1.60
Feb. 16	1.89	1.79	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------
Feb. 21	------	------	1.16	1.19	1.22	1.25	------	1.31	1.34	1.37	1.40	1.43	1.46	1.49	1.52	1.55	1.58	1.61	1.64	1.67	1.70	1.73	1.76
Apr. 23	------	------	1.08	1.11	1.14	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20
May 16	------	------	------	------	------	------	------	1.23	1.26	1.29	1.32	1.35	1.38	1.41	1.44	1.47	1.50	1.53	1.56	1.59	1.62	1.65	1.68
May 21	------	------	1.16	1.19	1.22	1.25	1.28	1.31	1.34	1.37	1.40	1.43	1.46	1.49	1.52	1.55	1.58	1.61	1.64	1.67	1.70	1.73	1.76
July 27	1.94	1.84	------	1.21	1.26	1.31	1.36	1.41	1.46	1.51	1.56	1.61	1.66	1.71	1.76	1.81	1.86	1.91	1.96	2.01	2.06	2.11	2.16
Average for year	1.93	1.83	1.16	1.20	1.23	1.27	1.31	1.34	1.38	1.41	1.45	1.49	1.52	1.56	1.59	1.63	1.66	1.70	1.73	1.77	1.80	1.84	1.87

[1] Sun Oil Co.

[2] Standard Oil Co. of Indiana.

Date	Mid-Continent field																													
	Kansas-Oklahoma; north and central Texas[1]																													Corsicana[2]
	Below 28°				28°–28.9°	29°–29.9°	30°–30.9°	31°–31.9°	32°–32.9°	33°–33.9°	34°–34.9°	35°–35.9°	36°–36.9°	37°–37.9°	38°–38.9°	39°–39.9°	40°–40.9°	41°–41.9°	42°–42.9°	43°–43.9°	44°–44.9°	45°–45.9°	46°–46.9°	47°–47.9°	48°–48.9°	49°–49.9°	50°–50.9°	51°–51.9°	52° and above	Heavy
Jan. 1	[2] $1.10				$1.12	$1.14	$1.16	$1.18	$1.20	$1.22	$1.24	$1.26	$1.28	$1.30	$1.32	$1.34	$1.36	$1.38	$1.40	$1.42	$1.44	$1.46	$1.48	$1.50	$1.52	$1.54	$1.56	$1.58	$1.60	$1.10
Feb. 16[2]	.75				.75	.75	.90	1.05	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-------
Feb. 21[1] [3]	------------------				.96	1.01	1.06	1.11	1.16	1.19	1.22	1.25	-----	1.31	1.34	1.37	1.40	1.43	1.46	1.49	1.52	1.55	1.58	1.61	1.64	1.67	1.70	1.73	1.76	-------
	Below 25°	25°–25.9°	26°–26.9°	27°–27.9°																	44° and above									
July 26[1]	$0.60	$0.67	$0.74	$0.81	.88	.95	1.02	1.09	-----	1.21	1.26	1.31	1.36	1.41	1.46	1.51	1.56	1.61	1.66	1.71	$1.76									-------
Aug. 2[2]	.60	.67	.74	.75	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	------------									-------
Av. for year	.73	.76	.79	.79	.95	1.00	1.06	1.11	1.17	1.20	1.24	1.28	1.31	1.35	1.39	1.43	1.46	1.50	1.54	1.58	------------									1.10

[1] Prairie Oil & Gas Co., and other major purchasing companies.

[2] Magnolia Petroleum Co.

[3] The Texas Co. posted a 5 cent decrease for each lower degree of gravity from 28° to 24°.

Posted price per barrel of petroleum at wells in 1928, by grades, with dates of change—Continued

Date	Mid-Continent field—Continued											
	South central and eastern Texas							South-west Texas, Mirando [2]	West Texas			
	Somerset [1]								Crane, Upton, Crockett, and Pecos [3]	Howard [4]		Iatan [4]
	Below 33°	33°–33.9°	34°–34.9°	35°–35.9°	36°–36.9°	37°–37.9°	38° and above					
Jan. 1	$1.05	$1.07	$1.09	$1.11	$1.13	$1.15	$1.17	$1.00	$0.60	$1.05		([5])
										Glasscock-Howard [6]	Chalk	
Jan. 14										$0.60	$0.80	$0.93
Jan. 26									.65			
Average for year	1.05	1.07	1.09	1.11	1.13	1.15	1.17	1.00	.62			

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[1] Grayburg Pipe Line Co.

[2] Humble Oil & Refining Co.

[3] Gulf Pipe Line Co., Humble Oil & Refining Co., Marland Refining Co. (Kay County Gas Co.).

[4] Magnolia Petroleum Co.

[5] On Mid-Continent gravity basis until Jan. 14.

[6] Except Chalk.

Date	Mid-Continent field—Continued														
	Panhandle[1]														
	Carson and Hutchinson														
Jan. 1	$0.75														
	Below 31°	31°–31.9°	32°–32.9°	33°–33.9°	34°–34.9°	35°–35.9°	36°–36.9°	37°–37.9°	38°–38.9°	39°–39.9°	40°–40.9°	41°–41.9°	42°–42.9°	43°–43.9°	44° and above
Feb. 21	$0.60	$0.65	$0.70	$0.73	$0.76	$0.79	$0.82	$0.85	$0.88	$0.91	$0.94	$0.97	$1.00	$1.03	$1.06
July 26	.69	.69	.76	.81	.86	.91	.96	1.01	1.06	1.11	1.16	1.21	1.26	1.31	1.36
Average for year	.66	.68	.73	.77	.80	.84	.87	.91	.94	.97	1.01	1.04	1.08	1.11	1.15

Date	Mid-Continent field—Continued																		
	Panhandle—Continued																		
	Gray[2]																		Wheeler[3]
	Below 26°	27°–27.9°	28°–28.9°	29°–29.9°	30°–30.9°	31°–31.9°	32°–32.9°	33°–33.9°	34°–34.9°	35°–35.9°	36°–36.9°	37°–37.9°	38°–38.9°	39°–39.9°	40°–40.9°	41°–41.9°	42°–42.9°	43°–43.9°	44° and above	
Jan. 1	------	------	$0.80	$0.82	$0.84	$0.86	$0.88	$0.90	$0.92	$0.94	$0.96	$0.98	$1.00	$1.02	$1.04	$1.06	$1.08	$1.10	$1.12	$0.75
Feb. 21	$0.60	$0.65	.70	.75	.80	.85	.90	.93	.96	.99	1.02	1.05	1.08	1.11	1.14	1.17	1.20	1.23	1.26	(3)
July 26	.68	.68	.68	------	.82	.89	.96	1.01	1.06	1.11	1.16	1.21	1.26	1.31	1.36	1.41	1.46	1.51	1.56	------
Average for year	.66	.68	.71	.76	.81	.87	.92	.96	1.00	1.04	1.07	1.11	1.15	1.18	1.22	1.26	1.30	1.33	1.37	------

[1] Marland Refining Co. (Kay County Gas Co.), Gulf Pipe Line Co., Humble Oil & Refining Co.

[2] Humble Oil & Refining Co., Gulf Pipe Line Co. (first posting Feb. 13).

[3] Wheeler crude posted at 10 cents less than Gray County for each grade over 29°.

Posted price per barrel of petroleum at wells in 1928, by grades, with dates of change—Continued

Date	Mid-Continent field—Continued																													
	North Louisiana and Arkansas																													
					Bull Bayou, Caddo, Crichton, De Soto, Haynesville, Homer, El Dorado[1]																									
	Bellevue[1] extra heavy below 32°	Cotton Valley[1]	Urania[2]	Calion below 24°[3]	Below 28°	28°–28. 9°	29°–29. 9°	30°–30. 9°	31°–31. 9°	32°–32. 9°	33°–33. 9°	34°–34. 9°	35°–35. 9°	36°–36. 9°	37°–37. 9°	38°–38. 9°	39°–39. 9°	40°–40. 9°	41°–41. 9°	42°–42. 9°	43°–43. 9°	44°–44. 9°	45°–45. 9°	46. 9°	47°–47. 9°	48°–48. 9°	49°–49. 9°	50°–50. 9°	51°–51. 9°	52° and above
Jan. 1	$1. 25	$0. 85	$0. 75	$0. 85	$1. 10	$1. 12	$1. 14	$1. 16	$1. 18	$1. 20	$1. 22	$1. 24	$1. 26	$1. 28	$1. 30	$1. 32	$1. 34	$1. 36	$1. 38	$1. 40	$1. 42	$1. 44	$1. 46	$1. 48	$1. 50	$1. 52	$1. 54	$1. 56	$1. 58	$1. 60
Feb. 7		. 75		. 75																										
Feb. 21					. 91	. 96	1. 01	1. 06	1. 11	1. 16	1. 19	1. 22	1. 25		1. 31	1. 34	1. 37	1. 40	1. 43	1. 46	1. 49	1. 52	1. 55	1. 58	1. 61	1. 64	1. 67	1. 70	1. 73	1. 76
		Below 36°[4]																												
Apr. 11		$0. 75																												
																						44° and above								
Aug. 2					. 81	. 88	. 95	1. 02	1. 09		1. 21	1. 26	1. 31	1. 36	1. 41	1. 46	1. 51	1. 56	1. 61	1. 66	1. 71	$1. 76								
Average for year	1. 25	. 76	. 75	. 76	. 89	. 95	1. 00	1. 06	1. 11	1. 17	1. 20	1. 24	1. 28	1. 31	1. 35	1. 39	1. 42	1. 46	1. 50	1. 53	1. 57									

[1] Standard Oil Co. of Louisiana.
[2] Louisiana Oil & Refining Co.
[3] Gulf Refining Co. of Louisiana.
[4] Higher grades posted with same price scale as Bull Bayou.

Date	Mid-Continent field—Continued																						
	North Louisiana and Arkansas—Continued																						
	Smackover [1]		Stephens [2]						Champagnolle [3]														
	Below 24°	24° and above	Below 28°	28°–28.9°	29°–29.9°	30°–30.9°	31°–31.9°	32° and above	Below 27°	27°–27.9°	28°–28.9°	29°–29.9°	30°–30.9°	31°–31.9°	32°–32.9°	33°–33.9°	34°–34.9°	35°–35.9°	36°–36.9°	37°–37.9°	38°–38.9°	39°–39.9°	40° and above
Jan. 1	$0.85	$1.00	$1.00	$1.02	$1.04	$1.06	$1.08	$1.10	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------
Feb. 7	.75	.90	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------
Feb. 23	------	------	.85	.87	.89	.91	.93	.95	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------
Apr. 3	------	------	------	------	------	------	------	------	$0.75	$0.91	$0.96	$1.01	$1.06	$1.11	$1.16	$1.19	$1.22	$1.25	$1.28	$1.31	$1.34	$1.37	$1.40
									Below 24°			24–27.9°			28–29.9°			30–32.9°			33° and above		
July 26	------	------	------	------	------	------	------	------	$0.75			$0.85			$1.00			$1.15			$1.25		
Aug. 2	------	------	.75	.79	.83	.87	.91	------	------			------			------			------			------		
Average for year	.76	.91	.83	.86	.89	.92	.94	.97	------			------			------			------			------		

[1] Standard Oil Co. of Louisiana.
[2] Atlantic Oil Producing Co.
[3] Root Refineries (Inc.).

Date	Gulf coast field																						
	Coastal Texas [1]																				Coastal Louisiana [2]		
	High Island	Batson, Saratoga	Grade A	Grade B																Markham [4]	Edgerley, Vinton	Jennings, Sorrento	Starks
				Below 25°	25°–25.9°	26°–26.9°	27°–27.9°	28°–28.9°	29°–29.9°	30°–30.9°	31°–31.9°	32°–32.9°	33°–33.9°	34°–34.9°	35°–35.9°	36°–36.9°	37°–37.9°	38°–38.9°	39°–39.9°	40° and above			
Jan. 1	(3)	$1.20	$1.20	$1.15	$1.17	$1.19	$1.21	$1.23	$1.25	$1.27	$1.29	$1.31	$1.33	$1.35	$1.37	$1.39	$1.41	$1.43	$1.45	$1.47	$1.00	$1.20	[5]$1.15	$1.20
Dec. 14	$1.00	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------
Av. for year	------	1.20	1.20	1.15	1.17	1.19	1.21	1.23	1.25	1.27	1.29	1.31	1.33	1.35	1.37	1.39	1.41	1.43	1.45	1.47	1.00	1.20	1.15	1.20

[1] Gulf Pipe Line Co. except as noted.
[2] Gulf Refining Co. of Louisiana.
[3] Included in graded scale until Dec. 14.
[4] The Texas Co.
[5] First posting Sorrento, June 1.

Posted price per barrel of petroleum at wells in 1928, by grades, with dates of change—Continued

Date	Rocky Mountain field [1]																			
	Byron	Big Muddy, Rock Creek	Cat Creek, Elk Basin, Greybull, Torchlight, Lance Creek, Osage	Grass Creek		Lake Basin	Lander and Simpson Ridge [2]	Lost Soldier [2]	Mule Creek	Pilot Butte	Rex-Lake	Salt Creek								
				Light	Heavy							28°–28.9°	29°–29.9°	30°–30.9°	31°–31.9°	32°–32.9°	33°–33.9°	34°–34.9°	35°–35.9°	36°–36.9°
Jan. 1	$2.25	$1.25	$1.33	$1.33	$0.90	$1.23	$0.80	$0.95	[3] $1.10	$1.7514	$1.10	$1.12	$1.14	$1.16	$1.18	$1.20	$1.22	$1.24	$1.26	$1.28
Feb. 21	------	------	------	------	------	------	------	------	------	------	------	.96	1.01	1.06	1.11	1.16	1.19	1.22	1.25	------
July 26	------	------	------	------	------	------	------	------	------	------	------	.88	.95	1.02	1.09	------	1.21	1.26	1.31	1.36
July 27	------	1.33	1.48	1.48	------	------	------	1.00	------	------	------	------	------	------	------	------	------	------	------	------
Average for year	2.25	1.28	1.39	1.39	.90	1.23	.80	.97	1.10	1.7514	1.10	.95	1.00	1.06	1.11	1.17	1.20	1.24	1.28	1.31

Date	Rocky Mountain field—Continued																			
	Salt Creek—Continued																Sunburst	Artesia	Hogback	Florence
	37–° 37.9°	38°–38.9°	39°–39.9°	40°–40.9°	41°–41.9°	42°–42.9°	43°–43.9°	44°–44.9°	45°–45.9°	46°–46.9°	47°–47.9°	48°–48.9°	49°–49.9°	50°–50.9°	51°–51.9°	52° and above				
Jan. 1	$1.30	$1.32	$1.34	$1.36	$1.38	$1.40	$1.42	$1.44	$1.46	$1.48	$1.50	$1.52	$1.54	$1.56	$1.58	$1.60	$1.35	$1.00	$1.38	$1.60
Jan. 25	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	1.50	------	------	------
Feb. 21	1.31	1.34	1.37	1.40	1.43	1.46	1.49	1.52	1.55	1.58	1.61	1.64	1.67	1.70	1.73	1.76	------	------	------	------
May 18	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	1.65	------	------	------
								44° and above												
July 26	1.41	1.46	1.51	1.56	1.61	1.66	1.71	$1.76									------	------	------	------
July 27	------	------	------	------	------	------	------	------									------	1.08	1.53	------
Average for year	1.35	1.39	1.43	1.46	1.50	1.54	1.58	------									1.58	1.03	1.44	1.60

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[1] The Ohio Oil Co. and Midwest Refining Co.

[2] Producers and Refiners Corporation.

[3] Posted May 1, 1927.

Field and date of change	California[1]													
	14°–14.9°	15°–15.9°	16°–16.9°	17°–17.9°	18°–18.9°	19°–19.9°	20°–20.9°	21°–21.9°	22°–22.9°	23°–23.9°	24°–24.9°	25°–25.9°	26°–26.9°	27°–27.9°
Alamitos Heights, Seal Beach, Signal Hill, Huntington Beach, Inglewood, Olinda, Brea Canyon, Athens, Dominguez, Rosecrans, Torrance, Richfield:[2]														
Jan. 1	$0.85	$0.85	$0.85	$0.85	$0.85	$0.85	$0.85	$0.86	$0.87	$0.88	$0.89	$0.90	$0.92	$0.94
Aug. 15								.89	.93	.97	1.01	1.05	1.09	1.13
Average for year	.85	.85	.85	.85	.85	.85	.85	.87	.89	.91	.94	.96	.98	1.01
Whittier-La Habra:														
Jan. 1	.85	.85	.85	.85	.85	.85	.85	.85	.85					
Aug. 15								.88	.91					
Average for year	.85	.85	.85	.85	.85	.85	.85	.86	.87					
Montebello:														
Jan. 1	.85	.85	.85	.85	.85	.85	.85	.85	.85	.85	.85	.86	.87	.88
Aug. 15							.86	.89	.92	.95	.98	1.01	1.04	1.07
Average for year	.85	.85	.85	.85	.85	.85	.85	.87	.88	.89	.90	.92	.93	.95
Santa Fe Springs:														
Jan. 1								.85	.85	.85	.85	.86	.87	.88
Aug. 15								.89	.92	.95	.98	1.01	1.04	1.07
Average for year								.87	.88	.89	.90	.92	.93	.95
Coyote Hills:														
Jan. 1	.85	.85	.85	.85	.85	.85	.85	.86	.87	.88	.89	.90	.91	.92
Aug. 15								.88	.91	.94	.97	1.00	1.04	1.08
Average for year	.85	.85	.85	.85	.85	.85	.85	.87	.89	.90	.92	.94	.96	.98
Elwood Terrace:														
Nov. 15[3]											.94	.98	1.02	1.06
Average for year											.94	.98	1.02	1.06

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[1] Standard Oil Co. of California.

[2] Alamitos Heights, Seal Beach, Signal Hill, Huntington Beach, 14° to 32.9°; Inglewood, Torrance, 14° to 28.9°; Olinda, Brea Canyon, Richfield, 14° to 30.9°; Athens, Rosecrans, Dominguez, 24° to 42.9°.

[3] First posting.

Posted price per barrel of petroleum at wells in 1928, by grades, with dates of change—Continued

Field and date of change	California—Continued													
	14°–14.9°	15°–15.9°	16°–16.9°	17°–17.9°	18°–18.9°	19°–19.9°	20°–20.9°	21°–21.9°	22°–22.9°	23°–23.9°	24°–24.9°	25°–25.9°	26°–26.9°	27°–27.9°
Newhall-McKittrick, Kern River, Midway-Sunset-Elk Hills, Buena Vista Hills, Lost Hills:[4, 5]														
Jan. 1	$0.75	$0.75	$0.75	$0.75	$0.75	$0.75	$0.77	$0.79	$0.81	$0.83	$0.85	$0.87	$0.89	$0.91
Aug. 15									.82	.86	.90	.95	1.00	1.05
Average for year	.75	.75	.75	.75	.75	.75	.77	.79	.81	.84	.87	.90	.93	.96
Coalinga:														
Jan. 1	.75	.75	.75	.75	.75	.75	.76	.77	.78	.80	.80	.81	.83	.85
Aug. 15							.77	.79	.82	.85	.88	.91	.94	.98
Average for year	.75	.75	.75	.75	.75	.75	.76	.78	.80	.81	.83	.85	.87	.90
Wheeler Ridge:														
Jan. 1	.75	.75	.75	.75	.75	.75	.76	.77	.78	.79	.80	.81	.82	.83
Aug. 15							.77	.79	.82	.85	.88	.91	.94	.97
Average for year	.75	.75	.75	.75	.75	.75	.76	.78	.80	.81	.83	.85	.87	.88

Field and date of change	California—Continued														
	28°–28.9°	29°–29.9°	30°–30.9°	31°–31.9°	32–°32.9°	33°–33.9°	34°–34.9°	35°–35.9°	36°–36.9°	37°–37.9°	38°–38.9°	39°–39.9°	40°–40.9°	41°–41.9°	42° and above
Alamitos Heights, Seal Beach, Signal Hill, Huntington Beach, Inglewood, Olinda, Brea Canyon, Athens, Dominguez, Rosecrans, Torrance, Richfield:[2]															
Jan. 1	$0.96	$0.98	$1.00	$1.03	$1.06	$1.09	$1.12	$1.15	$1.18	$1.21	$1.24	$1.27	$1.30	$1.33	$1.36
Aug. 15	1.17	1.21	1.25	1.30	1.35	1.41	1.47	1.53	1.59	1.65	1.71	1.77	1.83	1.89	1.95
Average for year	1.04	1.07	1.09	1.13	1.17	1.21	1.25	1.29	1.34	1.38	1.42	1.46	1.50	1.54	1.58
Whittier-La Habra:															
Jan. 1															

Aug. 15	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------
Average for year	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------
Montebello:															
Jan. 1	.89	.90	.91	------	------	------	------	------	------	------	------	------	------	------	------
Aug. 15	1.10	1.13	1.16	------	------	------	------	------	------	------	------	------	------	------	------
Average for year	.97	.99	1.00	------	------	------	------	------	------	------	------	------	------	------	------
Santa Fe Springs:															
Jan. 1	.89	.91	.93	.95	.97	.99	1.01	1.03	1.06	1.09	1.12	1.15	------	------	------
Aug. 15	1.10	1.15	1.20	1.25	1.30	1.35	1.40	1.45	1.50	1.55	1.60	1.65	------	------	------
Average for year	.97	1.00	1.03	1.06	1.10	1.13	1.16	1.19	1.23	1.26	1.30	1.34	------	------	------
Coyote Hills:															
Jan. 1	.93	.94	.95	------	------	------	------	------	------	------	------	------	------	------	------
Aug. 15	1.12	1.16	1.20	------	------	------	------	------	------	------	------	------	------	------	------
Average for year	1.00	1.02	1.04	------	------	------	------	------	------	------	------	------	------	------	------
Elwood Terrace:															
Nov. 15[3]	1.10	1.14	1.18	1.23	1.28	1.34	1.40	1.46	1.52	1.58	1.64	1.70	1.76	1.82	1.88
Average for year	1.10	1.14	1.18	1.23	1.28	1.34	1.40	1.46	1.52	1.58	1.64	1.70	1.76	1.82	1.88
Newhall-McKittrick, Kern River, Midway-Sunset-Elk Hills, Buena Vista Hills, Lost Hills: [4] [5]															
Jan. 1	.93	.96	.99	1.02	1.05	1.08	1.11	------	------	------	------	------	------	------	------
Aug. 15	1.10	1.16	1.22	1.28	1.34	1.40	1.46	------	------	------	------	------	------	------	------
Average for year	.99	1.04	1.08	1.12	1.16	1.20	1.24	------	------	------	------	------	------	------	------
Coalinga:															
Jan. 1	.87	.89	.91	.93	.95	.97	.99	1.01	------	------	------	------	------	------	------
Aug. 15	1.02	1.06	1.10	1.14	1.18	1.22	1.26	1.30	------	------	------	------	------	------	------
Average for year	.93	.95	.98	1.01	1.04	1.06	1.09	1.12	------	------	------	------	------	------	------
Wheeler Ridge:															
Jan. 1	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------
Aug. 15	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------
Average for year	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------

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[2] Alamitos Heights, Seal Beach, Signal Hill, Huntington Beach, 14° to 32.9°; Inglewood, Torrance, 14° to 28.9°; Olinda, Brea Canyon, Richfield, 14° to 30.9°; Athens, Rosecrans Dominguez, 24° to 42.9°.

[3] First posting.

[4] Newhall-McKittrick, Kern River, 14° to 19.9°; Midway-Sunset-Elk Hills, Buena Vista Hills, 14° to 33.9°; Lost Hills, 14° to 34.9°.

[5] Effective Oct. 2. Standard Oil Co. of California discontinued contracting for the purchase of Kern River crude under 14°; crude under 14° gravity to be purchased on daily runs posted as follows: 11° to 11.9° $0.45; 12° to 12.9°, $0.55; 13° to 13.9°, $0.65.

WELLS

During 1928 a total of 22,331 wells was completed, making 763,095 in all since the beginning of the industry in 1859. Of this number 158,862, or 21 per cent, were dry holes, whereas of the 1928 completions 7,078, or 32 per cent, were dry. (See fig. 37.) The ratio in 1928 represents the highest percentage of dry holes in any recent year and probably in all past time. The increase in the proportion of gas wells—from 10 per cent in 1927 to 12 per cent in 1928—is also noteworthy. Completions in 1928 were at their lowest point in January and from that time on increased more or less steadily until the peak was reached in October.

The total number of producing oil wells in the United States, as of December 31, 1928, was 327,800, as compared with 323,300 at the end of 1927. The average production per well per day was 7.6 barrels, as compared with 7.7 barrels in 1927. The average production per well per day in Texas increased because of the large wells completed in west Texas, but the average in Oklahoma declined. The production per well per day in California increased from 55.9 barrels in 1927 to 57.6 barrels in 1928, and the State easily retained first place in this respect. The increase in California resulted primarily from the closing in of a large number of small heavy-oil producers in the older fields.

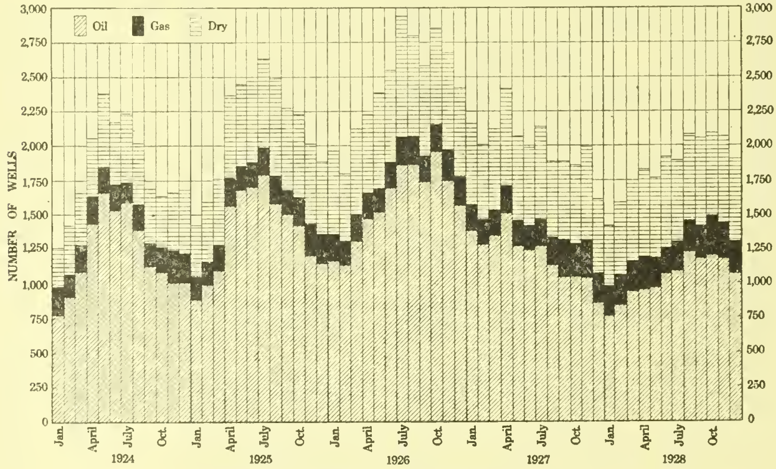

FIGURE 37.—Wells drilled, 1924–1928, by months

The outstanding points of interest regarding completions by districts or fields in 1928 were as follows: Huntington Beach, which had more completions than any other field in California in 1927, fell off materially in 1928, but the loss was more than compensated by the increase in completions at Long Beach; the increase of more than 100 per cent in the combined completions in Daviess and Ohio Counties, Ky., focused attention on the growing importance of the western part of that State in production; the number of oil wells completed in the coastal fields of Louisiana increased in 1928, but completions in the northern fields were only one-fourth as many as in 1927; no oil wells were brought in at Saginaw, Mich., in 1928, compared with 213 in 1927; the total number of completions in Ohio increased in 1928 as the result of a material increase in the number of gas wells brought in; the number of oil wells completed in the Greater Seminole district in 1928 was more than 400 less than in 1927; the Bradford field continued to lead the country in oil-well completions, with 1,540 in 1928; the record of completions in north Texas focused attention on the growth in importance of Wichita and Wilbarger Counties; oil-well completions in the Panhandle were only one-third of the 1927 total, but the decline was virtually offset by the increase in the Winkler field (west Texas) alone; and oil-well completions in the Salt Creek field of Wyoming fell from 187 in 1927 to 44 in 1928.

Wells drilled for oil and gas in the United States, 1859–1928

Year	Wells completed	Dry holes		Year	Wells completed	Dry holes		Year	Wells completed	Dry holes	
		Total	Percentage			Total	Percentage			Total	Percentage
1859–1907	[1]287,922	[1]54,940	19	1915	14,157	2,981	21	1923	24,438	5,883	24
1908	16,909	3,214	19	1916	24,619	4,039	16	1924	21,888	5,044	23
1909	18,327	3,404	19	1917	23,407	4,851	21	1925	25,623	6,734	26
1910	14,940	2,422	16	1918	25,687	5,613	22	1926	29,319	7,965	27
1911	13,768	2,363	17	1919	29,173	5,986	21	1927	24,143	7,210	30
1912	17,180	2,855	17	1920	33,911	7,364	22	1928	22,331	7,078	32
1913	25,590	4,282	17	1921	21,937	5,160	24				
1914	23,137	4,142	18	1922	24,689	5,332	22		763,095	158,862	21

[1] From Papers on the Conservation of Mineral Resources, U. S. Geol. Survey Bull. 394, 1909, pp. 30–50.

Approximate number of producing oil wells in the United States, December 31, 1926–1928

State	1926		1927		1928	
	Approximate number of wells	Average production per well per day (barrels)	Approximate number of wells	Average production per well per day (barrels)	Approximate number of wells	Average production per well per day (barrels)
Arkansas	4,500	37.2	4,550	24.2	4,520	19.3
California [1]	[1] 11,330	55.0	[1] 11,280	55.9	[1] 10,710	57.6
Colorado	130	72.2	170	51.7	210	39.9
Illinois	16,270	1.3	16,240	1.2	16,340	1.1
Indiana:						
Southwestern	990	1.8	1,100	1.9	1,140	2.3
Northeastern	1,060	.4	960	.3	900	.3
Total Indiana	2,050	1.1	2,060	1.1	2,040	1.4
Kansas	19,230	6.0	19,600	5.8	19,800	5.4
Kentucky	13,300	1.3	13,500	1.4	13,740	1.5
Louisiana:						
Gulf coast	240	45.4	250	56.5	320	67.6
Northern	3,950	14.0	4,000	12.2	3,500	10.8
Total Louisiana	4,190	16.0	4,250	14.8	3,820	14.8
Michigan	90	5.3	300	6.2	400	4.6
Montana	830	29.8	980	15.3	1,100	10.5
New Mexico	230	24.7	250	14.0	260	10.1
New York	16,150	.3	16,740	.4	16,500	.4
Ohio:						
Central and eastern	21,150	.7	20,100	.8	20,950	.7
Northwestern	18,100	.3	17,500	.3	16,950	.3
Total Ohio	39,250	.5	37,600	.5	37,900	.5
Oklahoma	61,600	8.1	61,750	12.3	62,900	11.0
Pennsylvania	76,800	.3	78,480	.3	78,600	.3

[1] American Petroleum Institute; does not include wells temporarily shut in.

Approximate number of producing oil wells in the United States, December 31, 1926–1928—Continued

State	1926		1927		1928	
	Approximate number of wells	Average production per well per day (barrels)	Approximate number of wells	Average production per well per day (barrels)	Approximate number of wells	Average production per well per day (barrels)
Texas:						
Gulf coast	2,520	45.5	2,600	50.3	2,850	39.6
Rest of State	26,510	14.5	29,400	16.7	32,900	19.1
Total Texas	29,030	17.4	32,000	19.5	35,750	20.8
West Virginia	20,150	.8	19,900	.8	19,600	.8
Wyoming	3,400	21.8	3,560	16.8	3,520	16.6
Other	[2] 70		[2] 90		[2] 90	
United States	318,600	6.8	323,300	7.7	327,800	7.6

[2] Alaska, Tennessee, and Utah.

Wells drilled for oil and gas in the United States, 1927–28, by months [1]

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	The year	
													Total	Percentage
1927														
Oil	1,383	1,287	1,348	1,511	1,273	1,240	1,276	1,132	1,048	1,049	1,038	857	14,442	60
Gas	187	182	185	191	183	181	190	204	267	236	270	215	2,491	10
Dry	588	540	595	709	610	564	677	552	574	572	687	542	7,210	30
	2,158	2,009	2,128	2,411	2,066	1,985	2,143	1,888	1,889	1,857	1,995	1,614	24,143	100
1928														
Oil	765	849	946	962	970	1,060	1,093	1,233	1,185	1,206	1,187	1,070	12,526	56
Gas	212	210	221	230	213	198	212	229	231	284	258	229	2,727	12
Dry	444	530	556	634	588	658	590	620	637	595	621	605	7,078	32
	1,421	1,589	1,723	1,826	1,771	1,916	1,895	2,082	2,053	2,085	2,066	1,904	22,331	100

[1] California dry gas wells not reported.

Wells drilled for oil and gas in the United States in 1928, by States and by counties or districts [1]

State and county or district	Oil	Gas	Dry	Total	Estimated average initial daily production per well (barrels)
Arkansas:					
Johnson		6		6	
Nevada	17	1	4	22	45
Ouachita	15	3	7	25	35
Union	125	18	136	279	606
Miscellaneous		1	31	32	
	157	29	178	364	491
Total, 1927	170	46	143	359	86

[1] For States east of California, Oil and Gas Journal; for California, American Petroleum Institute.

Wells drilled for oil and gas in the United States in 1928, by States and by counties or districts—Continued

State and county or district	Oil	Gas	Dry	Total	Estimated average initial daily production per well (barrels)
California:					
Coalinga	9	(2)	4	13	32
Coyote	4		1	5	146
Dominguez	5		1	6	297
Elwood-Goleta	4		6	10	3, 868
Fruitvale	6		1	7	557
Fullerton	7		1	8	1, 290
Huntington Beach	54		15	69	198
Inglewood	8			8	366
Kern River	70		6	76	180
Kettleman Hills	1			1	4, 000
Lawndale	1			1	1, 100
Long Beach	245		16	261	1, 384
Lost Hills-Belridge	24		1	25	44
McKittrick	6		2	8	79
Midway-Sunset	63		11	74	220
Montebello	5			5	99
Mount Poso	22		10	32	341
Potrero	2		1	3	1, 100
Richfield	18		5	23	304
Rincon	25		1	26	553
Rosecrans	2		1	3	306
Round Mountain	14		3	17	430
Santa Fe Springs	38		1	39	3, 751
Santa Maria	9			9	244
Seal Beach	14		10	24	521
Torrance	2		1	3	71
Ventura Avenue	41		3	44	1, 866
Ventura-Newhall	8		17	25	62
Wheeler Ridge	4			4	63
Miscellaneous	1		73	74	20
	712	(2)	191	903	957
Total, 1927	901	(2)	281	1, 182	533
Colorado:					
Boulder			5	5	
Fremont	41		33	74	92
Larimer	9		4	13	257
Moffat	10		7	17	705
Routt	9			9	74
Miscellaneous		1	21	22	
	69	1	70	140	200
Total, 1927	60	7	53	120	217
Illinois:					
Clark	4		5	9	21
Crawford	26	6	12	44	19
Cumberland	1		2	3	3
Lawrence	24		4	28	17
Morgan	1			1	8
St. Clair	1		2	3	25
Wabash	19	2	19	40	35
Miscellaneous			9	9	
	76	8	53	137	22
Total, 1927	88	8	65	161	26
Indiana:					
Northeastern—					
Adams	5			5	11
Jay	3		7	10	10
Madison	1	1	2	4	10
Steuben	1			1	5
Miscellaneous		15	14	29	
	10	16	23	49	10
Total, 1927	32	7	21	60	18

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[2] Not reported.

Wells drilled for oil and gas in the United States in 1928, by States and by counties or districts—Continued

State and county or district	Oil	Gas	Dry	Total	Estimated average initial daily production per well (barrels)
Indiana—Continued.					
Southwestern—					
Daviess	2		3	5	9
Gibson	18	5	19	42	31
Pike	7	4	10	21	26
Spencer	7	1	8	16	13
Sullivan	18	1	9	28	28
Vigo	24		3	27	41
Miscellaneous		11	7	18	
	76	22	59	157	31
Total, 1927	76	24	86	186	42
Total Indiana, 1928	86	38	82	206	28
1927	108	31	107	246	35
Kansas:					
Anderson	65	1	21	87	56
Butler	65		52	117	207
Chautauqua-Elk	48	14	36	98	78
Clay	1			1	20
Cowley	20	34	60	114	63
Greenwood	131	12	83	226	119
McPherson	2	11	6	19	190
Marion	41		42	83	116
Miami	3	1	6	10	6
Montgomery	59	11	20	90	21
Morris	1	3	6	10	30
Rooks	4		7	11	67
Russell	22	1	8	31	269
Sedgwick	3		2	5	1,090
Sumner	102	12	29	143	462
Woodson	4		12	16	20
Miscellaneous	16	15	65	96	13
	587	115	455	1,157	172
Total, 1927	685	79	569	1,333	143
Kentucky:					
Allen	20		26	46	
Barren	89		51	140	28
Breckinridge	13		3	16	15
Butler	1			1	20
Daviess	220	8	117	345	54
Estill	42		20	62	3
Floyd-Knott	1	10		11	50
Hancock	10	1	11	22	17
Henderson-Union	2	1	1	4	20
Johnson-Magoffin	33		3	36	10
Lee-Owsley	2	3	3	8	27
McLean	2		12	14	18
Ohio	359	15	145	519	53
Warren	26		5	31	15
Wayne	19		9	28	7
Webster	2	1		3	25
Wolfe	16		4	20	7
Miscellaneous	14	9	14	37	7
	871	48	424	1,343	41
Total, 1927	787	40	330	1,157	39
Louisiana:					
Gulf coast—					
Bayou Bouillon	5		4	9	1,216
Edgerley	15	1	11	27	74
Hackberry	27		22	49	1,186
Jennings	24		18	42	101
Lockport	16		8	24	239
Sorrento	4		4	8	2,025
Starks	4		5	9	883
Sulphur	10		5	15	1,800
Sweet Lake	4		1	5	2,025
Vinton	20	1	7	28	74
Welsh	2		1	3	27
Miscellaneous	7	2	69	78	15
	138	4	155	297	615
Total, 1927	115	3	84	202	526

Wells drilled for oil and gas in the United States in 1928, by States and by counties or districts—Continued

State and county or district	Oil	Gas	Dry	Total	Estimated average initial daily production per well (barrels)
Louisiana—Continued.					
Northern—					
Bossier	5	49	28	82	47
Caddo	37	6	57	100	116
Grant	2		6	8	28
La Salle	4		9	13	49
Morehouse		20	14	34	
Ouachita		36	4	40	
Richland		43	20	63	
Sabine	3		10	13	136
Union	3	19	11	33	17
Webster	8	46	19	73	657
Miscellaneous	2	10	57	69	38
	64	229	235	528	165
Total, 1927	252	177	297	726	160
Total Louisiana, 1928	202	233	390	825	472
1927	367	180	381	928	275
Michigan:					
Gratiot	2		1	3	11
Isabella	3			3	122
Midland	1			1	44
Monroe	4			4	51
Muskegon	89	28	19	136	215
Miscellaneous		1	6	7	
	99	29	26	154	200
Total, 1927	217	3	44	264	20
Montana:					
Cat Creek	3		3	6	27
Fallon		7	1	8	
Kevin-Sunburst	101	45	77	223	156
Pondera	69	1	7	77	94
Teton	10		13	23	32
Miscellaneous		3	19	22	
	183	56	120	359	124
Total, 1927	243	54	196	493	121
New Mexico:					
Eddy	11	1	10	22	120
Lea	4		8	12	225
McKinley			10	10	
San Juan		5	5	10	
Miscellaneous			12	12	
	15	6	45	66	148
Total, 1927	41	6	66	113	72
Ohio:					
Central and eastern—					
Ashland	25	48	40	113	17
Athens	19	86	36	141	2
Coshocton	21	20	8	49	65
Cuyahoga	11	20	10	41	32
Fairfield	9	5	5	19	15
Guernsey	43	8	5	56	36
Hocking	24	6	11	41	32
Holmes	22	47	25	94	28
Knox	13	20	11	44	32
Licking	149	23	25	197	22
Meigs	64	23	24	111	7
Muskingum	22	9	11	42	65
Perry	101	21	16	138	106
Stark	1	2	4	7	30
Miscellaneous	136	158	109	403	5
	660	496	340	1,496	34
Total, 1927	626	433	302	1,361	24

Wells drilled for oil and gas in the United States in 1928, by States and by counties or districts—Continued

State and county or district	Oil	Gas	Dry	Total	Estimated average initial daily production per well (barrels)
Ohio—Continued.					
Northwestern—					
Allen	27		1	28	29
Auglaize	13		3	16	14
Darke	3	1		4	17
Hancock	11	1	2	14	24
Hardin	2	8		10	25
Mercer	6	2		8	10
Ottawa	3	2		5	23
Seneca	35	1	36	72	124
Shelby	4		2	6	14
Van Wert	3			3	9
Wood	16	1	7	24	11
Miscellaneous	7	3	4	14	5
	130	19	55	204	47
Total, 1927	211	16	35	262	14
Total Ohio, 1928	790	515	395	1,700	36
1927	837	449	337	1,623	21
Oklahoma:					
Carter	87	3	18	108	189
Creek	122	42	137	301	184
Grady	20	99	25	144	86
Jefferson	39	2	21	62	65
Kay	17	59	73	149	182
Lincoln	6	1	4	11	352
Logan	22	6	12	40	826
Muskogee	199	40	189	428	26
Okfuskee	58	12	27	97	151
Okmulgee	86	52	114	252	21
Osage	208	35	68	311	241
Pontotoc	77	17	37	131	281
Pottawatomie	257	4	30	291	1,232
Seminole	445	18	133	596	1,162
Stephens	155	21	93	269	133
Tulsa	28	14	49	91	64
Miscellaneous	135	66	197	398	44
	1,961	491	1,227	3,679	518
Total, 1927	2,562	508	1,443	4,513	769
Pennsylvania and New York:					
Allegany	464	6	4	474	2
Bradford	1,540	11	21	1,572	2
Butler-Armstrong	69	24	15	108	2
Middle Field	76	2	5	83	2
Venango-Clarion	181	66	24	271	1
Southwestern Pennsylvania—					
Allegheny	15	16	4	35	5
Beaver	8		5	13	2
Greene	13	38	18	69	8
Washington	5	4	7	16	5
Miscellaneous	2	2	1	5	500
	2,373	169	104	2,646	2
Total, 1927	2,671	190	105	2,966	3
Tennessee:					
Clay	32	5	9	46	84
Jackson	9		2	11	52
Overton		1	1	2	
Putnam		1	1	2	
Miscellaneous			5	5	
	41	7	18	66	77
Total, 1927	49	2	16	67	81
Texas:					
Gulf coast—					
Barbers Hill	6		7	13	814
Batson	33		6	39	24
Big Creek	17		5	22	524
Blue Ridge	83		26	109	673
Boling	40	2	115	157	344
Damon Mound	4			4	250

Wells drilled for oil and gas in the United States in 1928, by States and by counties or districts—Continued

State and county or district	Oil	Gas	Dry	Total	Estimated average initial daily production per well (barrels)
Texas—Continued.					
Gulf coast—Continued.					
Dewalt	5	2	3	10	1,200
Goose Creek	23		8	31	52
High Island	10		5	15	552
Hull	53	1	16	70	368
Humble	11		3	14	279
Liberty	54	1	18	73	493
Markham	9		5	14	144
Nash	8		10	18	1,066
North Dayton	1		1	2	5,220
Orange	35		17	52	270
Orchard	2		4	6	700
Pierce Junction	56		27	83	948
Raccoon Bend	5	2	4	11	1,489
Saratoga	15		6	21	31
Sourlake	20		7	27	58
Spindletop	127		40	167	826
West Columbia	6		1	7	298
Miscellaneous	16	3	139	158	325
	639	11	473	1,123	543
Total, 1927	549	13	381	943	840
Rest of State—					
North, central, eastern, and southwestern—					
Anderson	8	2	8	18	179
Archer	232		257	489	60
Brown	310	29	279	618	92
Bruner (Salt Flat)	22		13	35	282
Callahan	35	4	78	117	23
Cherokee	1		7	8	504
Coleman	74	30	143	247	106
Cooke	22	1	27	50	27
Dale	25			25	72
Eastland	80	28	106	214	189
Harrison		21	8	29	
Haskell	1		5	6	46
Jack	18		46	64	81
Kingsville	3	3	5	11	48
Limestone	3	2	20	25	125
Lockhart	1		11	12	700
Luling	30		5	35	31
Mirando	96	119	69	284	318
Montague	74	6	17	97	31
Palo Pinto	4	9	21	34	24
Panola	3	60	19	82	9
Refugio	6	32	10	48	221
Roxana-Larremore	12			12	110
Shackelford	175	8	92	275	90
Shelby	3		3	6	57
Somerset	24			24	9
Stephens	27	16	39	82	75
Throckmorton	14		21	35	38
Wichita	331		189	520	45
Wilbarger	290	2	94	386	320
Yoast (Bastrop County)	2			2	325
Young	248	1	335	584	59
Miscellaneous	22	61	295	378	33
	2,196	434	2,222	4,852	121
Total, 1927	2,278	346	2,132	4,756	133
Panhandle—					
Gray	142	29	35	206	406
Hutchinson	55	8	3	66	124
Moore	2	5		7	1,115
Wheeler	2	35	4	41	38
Miscellaneous	6	23	47	76	230
	207	100	89	396	329
Total, 1927	623	94	87	804	286
West Texas—					
Crane	35		10	45	405
Crockett	14	1	29	44	211
Fisher	6		4	10	484

Wells drilled for oil and gas in the United States in 1928, by States and by counties or districts—Continued

State and county or district	Oil	Gas	Dry	Total	Estimated average initial daily production per well (barrels)
Texas—Continued.					
Rest of State—Continued.					
West Texas—Continued.					
Glasscock	1	----------	6	7	280
Howard	132	2	15	149	713
Irion	1	----------	8	9	7
Jones	37	----------	19	56	306
Loving	7	----------	3	10	80
Mitchell	4	----------	6	10	93
Pecos	210	----------	53	263	14,055
Reagan	33	----------	10	43	176
Runnels	3	1	16	20	169
Upton	7	----------	11	18	597
Winkler	448	9	30	487	5,494
Miscellaneous	----------	----------	87	87	----------
	938	13	307	1,258	5,917
Total, 1927	666	6	243	915	1,590
Total "Rest of State," 1928	3,341	547	2,618	6,506	1,761
1927	3,567	446	2,462	6,475	432
Total Texas, 1928	3,980	558	3,091	7,629	1,565
1927	4,116	459	2,843	7,418	486
Utah:					
Grand	----------	4	2	6	----------
Uintah	----------	1	----------	1	----------
Miscellaneous	----------	----------	5	5	----------
	----------	5	7	12	----------
Total, 1927	----------	1	13	14	----------
West Virginia:					
Boone	10	74	9	93	9
Calhoun	19	37	6	62	7
Clay	6	5	----------	11	21
Jackson	2	2	3	7	18
Lewis	1	16	2	19	1
Marion	1	16	12	29	3
Mingo	3	6	1	10	25
Ritchie	46	37	25	108	12
Roane	38	12	4	54	16
Wayne	1	10	3	14	25
Wetzel-Tyler	15	18	15	48	45
Miscellaneous	58	171	51	280	2
	200	404	131	735	12
Total, 1927	272	408	160	840	13
Wyoming:					
Big Horn	3	1	5	9	18
Carbon	3	3	2	8	84
Converse	2	----------	----------	2	75
Fremont	2	2	3	7	200
Hot Springs	1	----------	3	4	100
Natrona	7	2	4	13	106
Niobrara	2	1	5	8	150
Park	27	1	4	32	439
Salt Creek	44	----------	3	47	249
Sublette	27	2	18	47	53
Uinta	3	----------	3	6	243
Weston	3	----------	1	4	28
Miscellaneous	----------	2	14	16	----------
	124	14	65	203	218
Total, 1927	268	19	52	339	499
Other States, 1928 [3]	----------	1	6	7	----------
1927 [3]	----------	1	6	7	----------
United States, 1928	12,526	[4] 2,727	7,078	[4] 22,331	668
1927	14,442	[4] 2,491	7,210	[4] 24,143	341

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[3] 1927, Florida and Mississippi; 1928, Alabama and Mississippi.
[4] California dry gas wells not reported.

GRAVITY OF CRUDE PETROLEUM

Estimated average gravity of crude petroleum from various fields in the United States in 1928

District or grade	Degrees A. P. I.	Specific gravity
Alaska: Katalla	44.0	0.806
Arkansas:		
Bradley	26.4	.896
Champagnolle	29.5	.879
El Dorado	34.4	.853
Irma	14.4	.970
Lisbon	34.0	.855
Smackover—		
Heavy	19.8	.935
Light	25.9	.899
Stephens	29.0	.882
California:		
Arroyo Grande	14.8	.967
Bardsdale	30.6	.873
Beverly Hills	18.5	.943
Casmalia	6.8	1.023
Cat Cañyon	15.9	.960
Coalinga	19.4	.938
Conejo	14.4	.970
Coyote Hills	25.0	.904
Dominguez	31.0	.871
Elk Hills	22.5	.919
Elwood	37.5	.837
Fullerton	22.4	.919
Goleta	42.0	.816
Half Moon Bay	44.3	.805
Huntington Beach	25.6	.901
Inglewood	18.4	.944
Kern River	14.1	.972
Lawndale	35.0	.850
Lompoc	20.0	.934
Long Beach	25.8	.900
Los Angeles	15.5	.963
Lost Hills-Belridge	25.5	.901
McKittrick	14.8	.967
Midway-Sunset	19.0	.940
Montebello	23.0	.916
Mount Poso	15.5	.963
Newhall	22.0	.922
Newport Beach	12.3	.984
Ojai	17.1	.952
Petaluma	19.7	.936
Piru	23.4	.914
Potrero	48.5	.786
Richfield	22.3	.920
Rincon	30.0	.876
Rosecrans	37.8	.836
Round Mountain	18.2	.945
Salt Lake	14.8	.967
Santa Fe Springs	33.2	.859
Santa Maria	23.0	.916
Santa Paula	24.0	.910
Sargent	17.1	.952
Seal Beach	24.2	.909
Sespe	26.7	.894
Simi	32.3	.864
South Mountain	28.2	.886
Summerland	13.6	.975
Torrance	20.7	.930
Ventura Avenue	30.2	.875
Wheeler Ridge	25.3	.902
Whittier	19.1	.940
Colorado:		
Canon City	32.0	.865
Florence	29.3	.880
Fort Collins	37.0	.840
Iles Dome	35.0	.850
Moffat	41.0	.820
Rangely	42.5	.813
Tow Creek	35.0	.850
Walden	51.0	.775
Illinois:		
"Illinois"	31.5	.868
Plymouth	34.2	.854
Waterloo	30.0	.876
Indiana:		
Northeastern ("Indiana")	35.5	.847
Southwestern ("Princeton")	33.0	.860
Kansas:		
Anderson	35.0	0.850
Augusta	34.0	.855
Big Sandy	23.0	.916
Churchill	36.0	.845
Eldorado	36.0	.845
Iola	19.0	.940
Leon-Weaver	34.0	.855
Lost Springs	37.0	.840
Paola-Rantoul	29.3	.880
Rainbow Bend	39.0	.830
Russell County	39.0	.830
Sedgwick	42.5	.813
Seely	40.0	.825
Sumner County	38.0	.835
Teeter	36.8	.841
Virgil	38.0	.835
Winfield	38.0	.835
Kentucky:		
Daviess County	35.8	.846
Ohio County	35.0	.850
Olympia	36.0	.845
Ragland	23.2	.915
Rodemer	29.0	.882
Scottsville	35.0	.850
Somerset	37.6	.837
Warren County	36.0	.845
Louisiana:		
Gulf coast (salt domes)—		
Anse la Butte	24.0	.910
Bayou Bouillon	30.2	.875
Edgerley	21.0	.928
Hackberry	21.0	.928
Iberia	21.0	.928
Jennings	24.3	.908
Lockport	24.8	.905
Sorrento	26.2	.897
Starks	21.0	.928
Sulphur	20.9	.929
Sweet Lake	29.5	.879
Vinton	18.6	.943
Welsh	22.0	.922
Rest of State—		
Bellevue	19.0	.940
Bull Bayou	39.5	.828
Caddo—		
Heavy	26.5	.896
Light	40.1	.825
Cotton Valley	29.0	.882
De Soto	36.0	.845
Elm Grove	29.5	.879
Haynesville	35.0	.850
Homer	36.2	.844
Urania	21.0	.928
Michigan:		
Midland	43.0	.811
Muskegon	38.4	.833
Saginaw	40.0	.825
Montana:		
Cat Creek	49.7	.781
Elk Basin	42.0	.816
Kevin-Sunburst	31.9	.866
Lake Basin	44.0	.806
Pondera	34.0	.855
New Mexico:		
Artesia	37.0	.840
Hogback	56.0	.755
Hospah	30.0	.876
Maljamar	33.0	.860
Rattlesnake	65.0	.720
Table Mesa	57.0	.751
New York	43.5	.809
Ohio:		
Northwestern ("Lima")	36.6	.842
Southeastern and central—		
Cleveland	38.2	.834
Corning	40.0	.825
Pennsylvania grade	42.5	.813
Wooster	38.1	.834

Estimated average gravity of crude petroleum from various fields in the United States in 1928—Continued

District or grade	Degrees A. P. I.	Specific gravity
Oklahoma:		
Allen	29.7	0.878
Blackwell	39.0	.830
Bowlegs	39.5	.828
Braman	41.0	.820
Bristow	34.0	.855
Burbank	37.6	.837
Cement	34.6	.852
Cromwell	38.0	.835
Cushing	39.4	.828
Davenport	43.2	.810
Duncan	35.4	.848
Earlsboro	40.0	.825
Fox	23.6	.912
Garber	45.6	.799
Glenn	34.0	.855
Graham	38.0	.835
Healdton	30.0	.876
Hewitt	33.5	.858
Little River	38.0	.835
Lovell-Marshall	40.5	.823
Papoose	38.0	.835
Pearson	38.0	.835
Ponca	40.0	.825
St. Louis	40.0	.825
Searight	38.2	.834
Seminole City	39.0	.830
Sholem-Alechem	32.0	.865
Thomas	42.0	.816
Tonkawa	42.0	.816
Walters	33.3	.859
Wewoka	38.5	.832
Wheeler	21.7	.924
Pennsylvania:		
Bradford	43.5	.809
Franklin	29.5	.879
Keister	32.5	.863
"Pennsylvania"	40.0	.825
Tennessee:		
Glen Mary	39.0	.830
Tinsleys Bottom	43.2	.810
Texas:		
Gulf coast (salt domes)—		
Barbers Hill	26.2	.897
Batson	20.6	.930
Big Creek	27.0	.893
Blue Ridge	30.0	.876
Boling	29.1	.881
Damon Mound	22.1	.921
Fannette	31.8	.867
Goose Creek	24.0	.910
High Island	28.0	.887
Hull	25.0	.904
Humble	19.4	.938
Kingsville	21.5	.925
Moore	34.5	.852
Nash	20.0	.934
Orange	23.7	.912
Piedras Pintas	42.0	.816
Pierce Junction	23.5	.913
Refugio	24.0	.910
Saratoga	19.0	.940
Sourlake	26.0	.898
South Liberty	22.3	.920
Spindletop	26.0	.898
Sugarland	28.0	.887
West Columbia	22.8	.917
Rest of State—		
East and south central—		
Boggy Creek	39.0	.830
Calliham	18.0	.947
Corsicana	34.0	.855
Currie	42.0	.816
Luling	26.8	.894
Texas—Continued.		
Rest of State—Continued.		
East and south central—Continued.		
Lytton Springs	38.0	0.835
Mexia	35.6	.847
Minerva	38.5	.832
Nigger Creek	38.5	.832
Powell	37.5	.837
Raccoon Bend	25.5	.901
Somerset	34.0	.855
Thrall	37.6	.837
Wortham	38.5	.832
North and central—		
Breckenridge	36.2	.844
Brownwood	34.0	.855
Burkburnett	37.4	.838
Caddo	37.2	.839
Cooke County	40.7	.822
Desdemona	37.2	.839
Electra	40.2	.824
Holliday	37.2	.839
Moran	39.0	.830
Nocona	22.0	.922
Noodle Creek	40.5	.823
Petrolia	36.8	.841
Ranger	37.0	.840
Strawn	35.6	.847
Panhandle	35.8	.846
Southwest—		
Albercas	23.0	.916
Bruni	18.0	.947
Hondo	19.0	.940
Mirando	23.0	.916
Randado	21.0	.928
West Texas—		
Big Lake	38.2	.834
Chalk	31.3	.869
Church-Fields	31.0	.871
Hendricks	30.0	.876
McCamey	28.0	.887
McElroy	32.0	.865
Westbrook	25.0	.904
World	29.7	.878
Yates	30.0	.876
West Virginia:		
Cabell	39.3	.829
Cabin Creek	47.0	.793
Kellys Creek	45.6	.799
"Pennsylvania"	42.7	.812
Wyoming:		
Big Muddy	32.4	.863
Dutton Creek	33.6	.857
Elk Basin	42.0	.816
Ferris	36.6	.842
Grass Creek	44.0	.806
Greybull	44.7	.803
Hamilton Dome	25.2	.903
La Barge	30.0	.876
Lance Creek	40.4	.823
Lander	23.4	.914
Lost Soldier	30.2	.875
Maverick	21.9	.922
Mule Creek	31.7	.867
Notches	20.5	.931
Oregon Basin	22.0	.922
Osage	37.6	.837
Pilot Butte	35.4	.848
Poison Spider	15.0	.966
Rex Lake	32.3	.864
Rock Creek	36.4	.843
Salt Creek	36.8	.841
Teapot	36.4	.843
Warm Springs	21.5	.925

PRODUCTION OF PETROLEUM AND ROYALTIES FROM WELLS UNDER FEDERAL CONTROL

The following tables were compiled from data received by the United States Geological Survey and the Office of Indian Affairs.

The production of crude petroleum on Government lands in 1928 amounted to 32,132,890.09 barrels, of which 5,242,108.39 barrels, valued at $5,379,722.67, was royalty oil. All three of these figures represent declines from 1927. The royalty from production on Indian lands declined to $10,701,281 in 1928 from $14,360,879 in 1927, but the loss was more than compensated by the increase in bonuses from the sale of leases.

Crude petroleum produced on Government lands, 1927 and 1928, under the operation of the leasing act of February 25, 1920

[From U. S. Geological Survey]

State and land office	1927			1928		
	Production (barrels)	Royalty		Production (barrels)	Royalty	
		Barrels	Value		Barrels	Value
California:						
Los Angeles	1,728,819.07	237,315.51	$239,749.82	1,318,893.39	163,915.24	$141,573.77
Sacramento, outside naval reserves	2,697,708.95	345,276.01	267,298.86	[1]4,074,008.85	[1]565,687.85	[1]452,933.20
Sacramento, inside naval reserves	5,102,307.02	1,172,048.30	983,425.31	[1]8,889,360.34	[1]2,106,800.41	[1]1,796,162.41
Visalia, outside naval reserves	2,797,458.99	361,142.10	301,650.14	(1)	(1)	(1)
Visalia, inside naval reserves	5,792,320.12	1,333,662.44	1,356,499.35	(1)	(1)	(1)
	18,118,614.15	3,449,444.36	3,148,623.48	14,282,262.58	2,836,403.50	2,390,669.38
Colorado:						
Denver	404,125.48	32,885.98	22,383.70	1,027,408.09	90,090.82	53,003.03
Glenwood Springs	381,598.21	21,962.36	23,379.77	-----------	-----------	-----------
	785,723.69	54,848.34	45,763.47	1,027,408.09	90,090.82	53,003.03
Louisiana: Baton Rouge	28,972.91	1,021.97	11,346.54	8,573.60	893.86	1,681.10
Montana:						
Billings	662,344.60	39,818.04	74,679.86	504,057.38	29,973.76	54,592.09
Great Falls	250,511.06	12,574.28	18,132.21	188,216.96	11,035.96	18,810.38
	912,855.66	52,392.32	92,812.07	692,274.34	41,009.72	73,402.47
New Mexico:						
Las Cruces	53,305.26	8,795.23	9,513.80	83,159.97	15,035.48	14,776.76
Santa Fe	110.59	22.12	66.36	518.29	103.66	131.92
	53,415.85	8,817.35	9,580.16	83,678.26	15,139.14	14,908.68
Oklahoma: Guthrie	622,767.31	105,670.97	173,847.03	546,027.22	83,321.74	132,569.39
Utah: Salt Lake City	-----------	-----------	-----------	3,522.20	413.01	544.07
Wyoming:						
Buffalo	35,115.90	4,020.84	5,744.89	53,124.31	5,345.36	7,587.42
Cheyenne, outside naval reserves	14,610,624.41	2,149,200.88	2,980,597.94	14,933,724.48	2,131,677.51	2,678,587.00
Cheyenne, inside naval reserves	313,892.42	39,236.57	54,517.26	-----------	-----------	-----------
Evanston	338,321.64	22,128.55	10,347.13	502,295.01	37,813.73	26,770.13
Lander	254,329.35	32,437.33	32,847.44	-----------	-----------	-----------
	15,552,283.72	2,247,024.17	3,084,054.66	15,489,143.80	2,174,836.60	2,712,944.55
	36,074,633.29	5,919,219.48	6,566,027.41	32,132,890.09	5,242,108.39	5,379,722.67

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[1] Visalia included with Sacramento.

Royalty receipts from production of oil and gas and bonuses paid for sale of leases on Indian reservations, fiscal years ended June 30, 1927 and 1928

[From Office of Indian Affairs]

Reservation	1927			1928		
	Oil and gas land leased during year (acres)	Receipts		Oil and gas land leased during year (acres)	Receipts	
		Bonus from sale of leases	Royalty from production		Bonus from sale of leases	Royalty from production
Five Civilized Tribes: Oil	78,266	$295,189	$3,522,896	58,810	$197,727	$4,349,792
Cheyenne and Arapaho: Oil	477	477	-----	15,559	30,029	-----
Chippewa	-----	-----	-----	1,520	-----	-----
Crow	7,776	780	-----	2,848	[1] 267	-----
Kiowa:						
Oil	23,281	18,545	13,013	29,693	33,921	10,041
Gas	-----	-----	4,084	-----	-----	6,512
Navajo (eastern): Oil	2,720	11,200	-----	640	2,936	-----
Navajo (northern): Oil	18,160	61,845	233,499	-----	-----	67,259
Osage:						
Oil	36,176	3,953	9,016,650	81,840	4,228,681	5,030,247
Gas			1,370,011			1,081,132
Pawnee: [2]						
Oil	14,209	68,722	138,437	2,020	17,368	85,044
Gas	-----	-----	6,576	-----	-----	13,339
Pottawatomie	-----	-----	-----	4,780	677	-----
Shawnee:						
Oil	18,424	222,307	39,465	1,307	50,986	41,077
Gas	-----	-----	3,186			1,124
Shoshone: Oil	1,852	2,350	13,062	-----	-----	15,628
Sioux	-----	-----	-----	4,960	-----	-----
Ute: Oil	160	336	-----	-----	-----	86
	201,501	685,704	14,360,879	203,977	4,562,592	10,701,281

[1] Incomplete.

[2] Includes Kaw, Otoe, Ponca, Tonkawa.

SUMMARY OF REFINERY STATISTICS

Refinery statistics, combined with statistics of crude petroleum and natural gasoline, are issued monthly by the Bureau of Mines. No attempt is made here to present other than an abbreviated summary of the major refined products for the 5-year period 1924 to 1928. Detailed statistics of refined products for 1928 are presented in Bureau of Mines Bulletin 318, Petroleum Refinery Statistics, 1928.

The consumption of crude petroleum at refineries continued to increase rapidly in 1928, when a total of 913,295,000 barrels was processed. Of this amount 835,711,000 barrels was domestic crude petroleum and 77,584,000 barrels was foreign crude petroleum. The figure for domestic crude in 1928 represents an increase of 7 per cent over 1927 and that for foreign crude petroleum an increase of 55 per cent. Notwithstanding the rapid increase in production of domestic crude in recent years, 1928 is the third successive year in which the percentage increase in use of foreign crude has exceeded the increase in use of domestic crude.

The production of gasoline at refineries amounted to 376,945,000 barrels in 1928, an increase of 14 per cent over 1927. The ratio of gasoline recovered to crude oil processed continued to increase steadily and in 1928 amounted to 41.3 per cent, compared with 39.9 per cent in 1927. Deducting the natural gasoline blended at refineries from the total refinery output of gasoline indicates that the yield of gasoline from crude oil alone in the years 1928 and 1927 was 37.4

and 36 per cent, respectively. The increase in yield of gasoline in 1928 was due to several reasons, two of which were the increased recovery from cracking and the use of higher-grade crude in California.

The consumption of gasoline continued to increase in 1928, but the rate of increase showed a tendency to fall back to a more conservative pace. The total indicated domestic demand for the year amounted to 328,489,000 barrels, an increase over 1927 of 11 per cent as compared with an increase of 13 per cent for 1927 over 1926. The daily average domestic demand for gasoline increased steadily each month through August, after which the seasonal element caused a gradual decline throughout the remainder of the year.

The situation as regards gasoline stocks constituted one of the bright features of the year for the refiner. Stocks did not accumulate in the spring months to the usual extent, which, combined with the increase in consumption, resulted in storage reaching the extremely low point of 26,378,000 barrels on September 30. At the rate of total demand (domestic demand plus exports) then prevailing, the stocks represented only 23 days supply. Gasoline stocks accumulated rapidly during November and December and as the year closed amounted to 33,066,000 barrels, compared with 33,316,000 barrels on January 1.

Exports of gasoline continued to gain and in 1928 amounted to 52,904,000 barrels, an increase of 19 per cent over 1927. Imports of gasoline continued to have comparatively little importance; they declined to 4,198,000 barrels from 5,002,000 barrels the year before.

The production of kerosene in 1928 was higher than in 1927—59,353,000 barrels in 1928 and 56,113,000 barrels in 1927—but the percentage yield declined from 6.8 to 6.5 per cent. The major portion of the increase in output was accounted for by exports, which rose from 19,537,000 barrels in 1927 to 22,034,000 barrels in 1928. Total indicated domestic demand for the year amounted to 36,235,000 barrels, a slight drop from 1927.

The production of gas oil and fuel oil in 1928 totaled 427,237,000 barrels, a recovery from the crude processed of 46.8 per cent, compared with 47.4 per cent in 1927. This decline was due mainly to increased cracking. Stocks of gas oil and fuel oil east of California showed comparatively little change in 1928, which, in conjunction with the increase in output, would indicate a small increase in consumption over 1927.

The trend in the statistics of lubricants again reversed itself in 1928, when both production and indicated domestic demand were higher. This condition was contrary to the expectations of those who maintain that oil-savers and reclaimed oil are reducing the demand for lubricating oils by motor vehicles.

The paraffin-wax industry was favored with an increased demand for its product both from domestic and foreign buyers in 1928 and experienced a comparatively prosperous year. Production increased, but stocks decreased from 150,638,000 pounds on January 1 to 110,344,000 pounds on December 31, 1928.

The production of petroleum coke in 1928 amounted to 1,426,600 short tons, as compared with 1,145,200 tons in 1927, an increase of 25 per cent. Part of the increase resulted from increased runs of crude oil to stills and part from a gain in cracking activity. Stocks continued to rise and on December 31 amounted to 436,900 tons.

The production of asphalt at refineries in 1928 was noteworthy in that it showed a decrease from 1927. The total output in 1928 was 3,296,800 short tons, as compared with 3,417,700 tons in 1927. The chief reason for the decrease was a drop in the production on the Atlantic seaboard, the most important producing area. Stocks of asphalt at refineries increased during 1928 but at a slower rate than in 1927.

Shortage, formerly termed "losses," at refineries totaled 29,040,000 barrels in 1928, the equivalent of 3.2 per cent of the total crude run to stills. This represented a decline from 3.4 per cent in 1927 and was probably due to improved methods and to a growth in use of pipe stills which handle large amounts of material in a short time.

Refinery statistics, 1924–1928

Thousands of barrels of 42 U. S. gallons except as otherwise indicated]

	1924	1925	1926	1927	1928
Crude oil run to stills:					
Domestic	597, 954	698, 582	734, 301	778, 729	835, 711
Foreign	45, 765	41, 338	44, 963	50, 106	77, 584
	643, 719	739, 920	779, 264	828, 835	913, 295
Natural gasoline run to stills or blended at refineries	12, 671	[1] 19, 636	[1] 27, 696	[1] 32, 162	[1] 35, 223
Stocks of crude oil (domestic and foreign) at refineries at end of year	40, 995	[2] 27, 157 [3] 29, 200	[2] 35, 475	[2] 39, 317	[2] 40, 529
Gasoline:					
Produced	213, 326	259, 601	299, 734	330, 435	376, 945
Imported	3, 453	3, 813	5, 540	5, 002	4, 198
Exported [4]	28, 967	31, 497	43, 313	44, 337	52, 904
Domestic demand	185, 003	223, 865	261, 813	296, 807	328, 489
Stocks at refineries at end of year	30, 823	38, 875	39, 023	33, 316	33, 066
Kerosene:					
Produced	60, 026	59, 689	61, 768	56, 113	59, 353
Imported	10	19	74	55	202
Exported [4]	21, 961	21, 212	22, 248	19, 537	22, 034
Domestic demand	36, 712	39, 969	38, 140	37, 491	36. 235
Stocks at refineries at end of year	8, 594	7, 121	8, 575	7, 715	9, 001
Gas oil and fuel oil:					
Produced	320, 476	364, 991	365, 195	393, 066	427, 237
Imported	12, 927	12, 245	14, 432	8, 124	7, 268
Exported [4]	37, 249	36, 088	38, 351	47, 391	44, 427
Domestic demand	292, 452	(5)	(5)	(5)	(5)
Stocks at refineries at end of year	[2] 19, 556	[2] 24, 681	[2] 24, 898	[2] 34, 022	[2] 34, 926
Lubricants:					
Produced	27, 498	31, 055	32, 293	31, 721	34, 658
Imported	11	37	33	8	13
Exported [4]	9, 103	9, 678	9, 435	9, 776	11, 023
Domestic demand	18, 124	20, 581	22, 568	21, 669	23, 168
Stocks at refineries at end of year	6, 420	7, 253	7, 576	7, 860	8, 340
Wax (thousands of pounds):					
Produced	516, 491	590, 577	645, 815	584, 347	630, 144
Stocks at refineries at end of year	89, 706	116, 391	185, 331	167, 214 [6] 150, 638	110, 344
Coke (thousands of short tons):					
Produced	761. 1	991. 0	995. 3	1, 145. 2	1, 426. 6
Stocks at refineries at end of year	97. 8	238. 4	290. 6	345. 1	436. 9
Asphalt (thousands of short tons):					
Produced	2, 545. 6	2, 677. 4	2, 922. 8	3, 417. 7	3, 296. 8
Stocks at refineries at end of year	97. 3	159. 4	193. 3	220. 8	235. 5
Shortage [7]	19, 590	22, 914	26, 928	28, 396	29, 040

Includes natural gasoline run through pipe lines in California.

[2] East of California.

[2] Includes 2,043,000 barrels in coastwise transit.

[4] Including shipments to Alaska, Hawaii, and Porto Rico.

[5] Figures not available.

[6] For comparison with 1928.

[7] Difference between total runs to stills and the volume of the classified products reported.

OIL SHALE AND SHALE OIL

The low price of fuel oil and other petroleum products had an adverse effect upon the shale-oil industry and, exclusive of the experimental plant of the Bureau of Mines at Rulison, Colo., no plants were operated during 1928.

The bureau's plant at Rulison, which was shut down June 30, 1927, was reopened in May, 1928, and began operations, using both the N. T. U. and Pumpherston retorts, in June. Barring temporary shutdowns due mainly to coking shale, these retorts were operated continuously throughout the remainder of 1928 and until June 30, 1929. During the period June to December, 1928, 1,189 short tons of shale was put through the Pumpherston retort, from which 29,739 gallons of shale oil was recovered, an average recovery of 25 gallons per ton. During the same period the N. T. U. retort handled 936 tons of shale, from which 22,207 gallons of shale oil was recovered, an average of 23.7 gallons per ton. The total for both types of retorts was thus 2,125 tons of shale treated, 51,946 gallons of shale oil produced, and an average recovery of 24.4 gallons per ton.

The output of oil shale in other countries continued, by comparison, to dwarf the industry in the United States. In Scotland, the leading country, the production of shale amounted to 2,070,826 metric tons (2,282,692 short tons) in 1928, a slight decrease from 1927. Production in Estonia, the only country which in any way rivals Scotland, rose to the new high level of 446,117 metric tons (491,759 short tons) in 1928, compared with 397,609 metric tons (438,288 short tons) in 1927.

World production of oil shale, 1924–1928, in metric tons

[Compiled under supervision of L. M. Jones, of the Bureau of Mines]

Country	1924	1925	1926	1927	1928
Australia:					
New South Wales	652	----------	----------	----------	----------
Tasmania	1,601	833	2,161	3,201	2,637
Estonia	233,631	288,104	431,678	397,609	446,117
France [1]	70,968	67,127	69,190	(2)	(2)
Germany (Bavaria)	530	400	10	480	670
Great Britain: Scotland	2,902,960	2,504,390	1,991,250	2,080,122	2,070,826
India, British	----------	41	----------	----------	----------
Italy	2,987	2,700	10,200	12,090	7,388
Russia [3]	11,684	1,130	1,871	9,434	(2)
Spain	(4)	67,500	(4)	54,337	54,110
Sweden	(5)	(5)	(5)	(5)	(2)
United States	[6] 21,200	(7)	5,500	7,600	1,928

[1] Includes some boghead coal.

[2] Data not available.

[3] Year ended Sept. 30.

[4] There is in operation in Puertollano a plant for the treatment of oil shale and impure coal to obtain oil, but no details of production are available.

[5] Data on production of oil shale not available; the following quantities of shale oil were extracted from alum shale: 1924, none; 1925, 12 tons; 1926, 51 tons; 1927, 22 tons.

[6] Estimated. Used in production of shale oil.

[7] Produced by one company; figures confidential and may not be disclosed.

COKE AND BY-PRODUCTS[1]

By F. G. Tryon and H. L. Bennit

REVIEW OF INDUSTRY IN 1928

Considering the industry as a whole, including both beehive and by-product coke, 1928 was a year of moderate activity. (See fig. 38.) Production exceeded that for 1927 but fell short of that for 1926 and 1923, as well as the war years. Stocks remained above the average throughout the year. (See figs. 39 and 53.) Exports increased, largely through the growing demand for domestic coke in Canada. Total consumption within the United States, following the trend of production, showed an increase over 1927 but failed to equal that of 1926 and some earlier years, reflecting the condition of the iron and steel industries. (See fig. 46.) But while the metallurgical demand was disappointing, consumption for domestic uses rose to new high levels, indicating, as in earlier years, that future expansion of coke consumption depends largely on the household fuel market. (See fig. 49.) The course of coke prices in 1928 was generally downward. (See fig. 40.)

The year was marked by further replacement of beehive by by-product coke. (See fig. 41.) Although the total output of 52,806,000 tons was but 3.4 per cent greater than in 1927 and actually 7 per cent less than in 1926, yet production of by-product coke broke all previous records, increasing from month to month throughout the year with but two interruptions. (See fig. 38.) The year's production of by-product coke was 48,313,000 tons, an increase of 3,936,000 tons over that of 1926, the previous maximum. On the other hand, the output of beehive coke was barely one-third as great as in 1926, amounting to only 4,493,000 tons. Of the total supply of coke in 1928 the by-product ovens contributed 91.5 per cent.

The declining importance of beehive coke was reflected in a further large reduction in the number of beehive ovens. On the contrary, the number of by-product ovens continued to increase. Four new by-product plants were completed during the year, and batteries of new ovens were fired at other plants. Few new commitments for additional ovens were made, however, and the number of by-product ovens under construction on December 31, 1928, was only 145, the smallest in any year since 1921.

Spot prices of coking coals f. o. b. mines were lower in 1928, and the cost delivered at the ovens also declined. The average cost of coal charged into by-product ovens, which has been falling since 1923, was $3.87 in 1927 and $3.57 in 1928. Low prices at the mines continued to favor the coking coals of the Appalachians in competition with the high-oxygen coking coals of the Middle West, and of the 71,164,000 tons purchased for by-product use in 1928 only 562,000 tons came from Illinois and 17,000 from western Kentucky. (See fig. 43.)

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[1] Work on manuscript completed December, 1929.

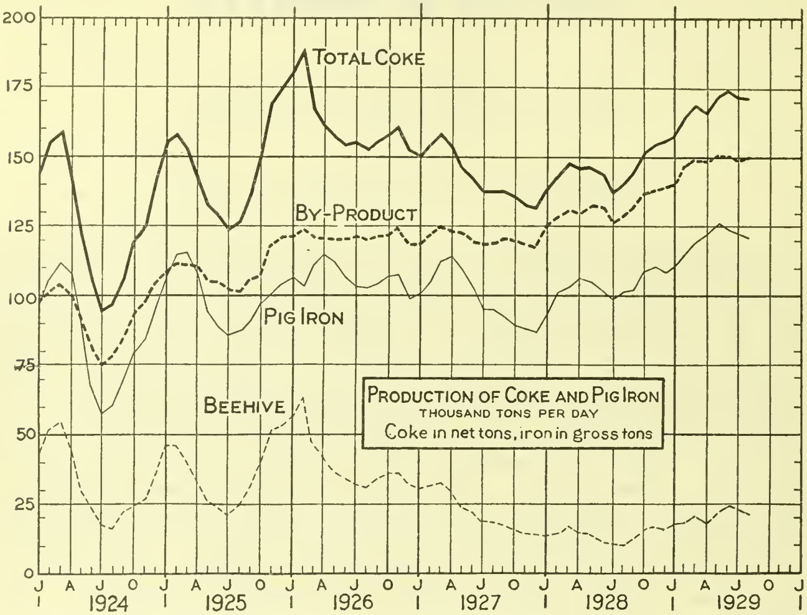

FIGURE 38.—Average daily production of beehive and by-product coke and of pig iron, by months, 1924–1929

The market for the by-products in 1928 showed a continuation of the tendencies apparent in the last five years. The yield of by-products per ton of coal carbonized continued to advance. (See fig. 57.) Receipts per gallon of tar again increased in 1928, and receipts per gallon of benzol and per pound of ammonium sulphate again declined. (See fig. 58.) Gas remains by far the most important

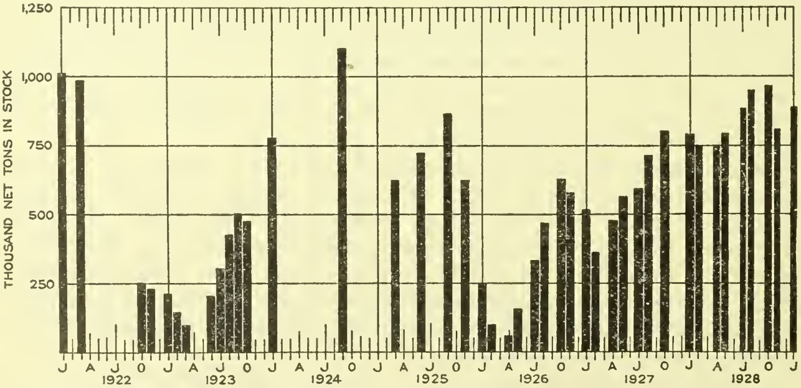

FIGURE 39.—Stocks of unsold coke on hand at a group of 21 by-product plants making coke suitable for domestic use and supplying gas for city distribution, 1922–1928. The figures represent a selected group of identical merchant plants. Total figures for all plants, including furnace plants and merchant plants completed since 1922, are given in Tables 46 and 48

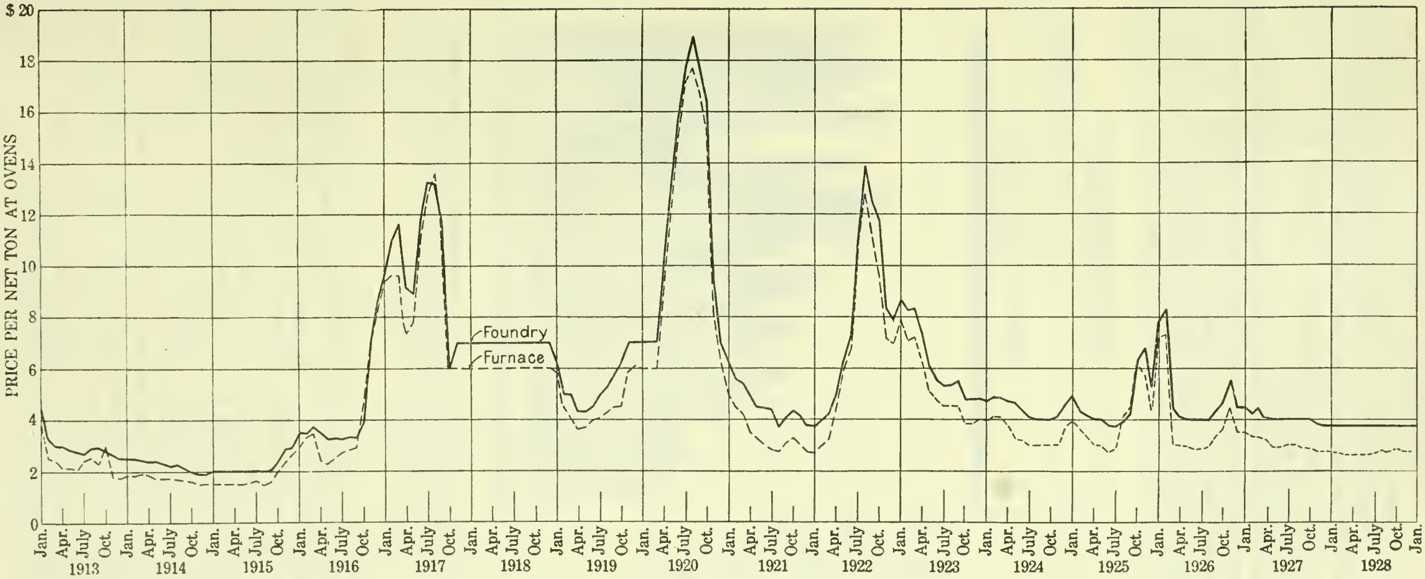

FIGURE 40.—Average monthly prices of spot or prompt Connellsville coke at ovens, 1913–1928, as quoted by Iron Age

by-product. In 1928 the gross return from surplus gas per ton of coke produced was $1.58 and the total for all by-products combined was $3.66. (See fig. 59.) A most significant development in 1928 was the installation of equipment for the recovery of creosote oil at a number of coke plants (Table 70), the total production of creosote oil being 12,386,000 gallons.

The decline in prices, already mentioned, affected all grades of coke. The average realization on merchant sales of by-product furnace coke, for example, declined from $5.58 in 1927 to $5.38; in the same period foundry coke declined from $7.80 to $6.98 and domestic coke from $6.90 to $6.23. In part these decreases reflected the declining cost of coking coal; but in part, also, they were due to relative weakness of the metallurgical demand and to active competition of other fuels in the household market. At the same time that sales of domestic by-product coke have been increasing (rising from 2,638,000 tons in 1923 to 6,254,000 in 1928—see fig. 49), other fuels have sought to hold or to strengthen their position in the domestic field. (See fig. 47.) As a result, prices of house fuels have been falling. (See fig. 50.)

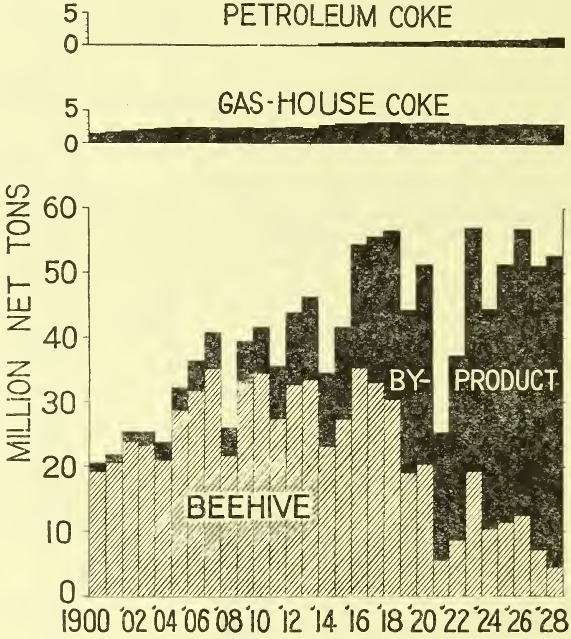

FIGURE 41.—Production of petroleum coke, gas-house coke, and beehive and by-product coke in the United States, 1900–1928. No figures on production of petroleum coke are available before 1914, in which year the production was 213,777 tons

Because of the growing interest in coke as a household fuel the coal division of the bureau was asked to prepare an exhibit on the economics of domestic coke for presentation at the annual meeting of the American Gas Association in October, 1929. In response to many requests the principal charts displayed at that exhibit have been incorporated in the present report (see especially figs. 41 to 53), and to make room for them much of the customary text discussion has been omitted.

ACKNOWLEDGMENTS

This report is based upon voluntary statistical returns by the producers of coke, for whose generous and continuing assistance thanks are cordially extended. Special mention should be made of the courtesy of operators of by-product coke plants in supplying monthly returns of coke output. The railroads have furnished weekly reports of cars of beehive coke loaded, which have been indispensable in preparing the current estimates of production of beehive coke and bituminous coal, and the United States Engineer Office has courteously supplied monthly reports of shipments on the Monongahela River and other waterways.

STATISTICAL SUMMARY

The principal statistical facts of the coke industry in 1928 are presented in Tables 1, 2, and 3.

TABLE 1.—*Salient statistics of the coke industry in 1928*

	By-product	Beehive	Total
Coke produced:			
Quantity net tons	48,313,025	4,492,803	52,805,828
Value	$236,515,204	$16,318,556	$252,833,760
Screenings and breeze produced:			
Quantity net tons	4,378,239	131,873	4,510,112
Value	$9,491,042	$173,895	$9,664,937
Coal charged into ovens:			
Quantity net tons	70,165,906	7,017,974	77,183,880
Value	$250,606,288	$13,161,141	$263,767,429
Average value	$3.57	$1.88	$3.42
Average yield in per cent of coal charged:			
Coke	68.9	64.0	68.4
Breeze (at plants actually recovering)	6.2	3.3	6.1
Ovens:			
In existence Jan. 1	12,475	49,795	62,270
In existence Dec. 31	12,544	41,288	53,832
Dismantled during year	375	8,299	8,674
In course of construction Dec. 31	145		145
Daily capacity of ovens in existence Dec. 31 net tons	165,363	(1)	(1)
Coke used by operator:			
In blast furnaces—			
Quantity net tons	32,942,532	367,314	33,309,846
Value	$145,237,868	$1,642,553	$146,880,421
In affiliated works—			
Quantity net tons	996,383	3,315	999,698
Value	$5,718,760	$15,564	$5,734,324
Disposal of coke:			
Sold for furnace use to affiliated corporations—			
Quantity net tons	3,136,547	808,123	3,944,670
Value	$15,007,542	$3,099,214	$18,106,756
Merchant sales of furnace coke—			
Quantity net tons	1,652,531	2,045,591	3,698,122
Value	$8,894,711	$6,699,956	$15,594,667
Sold for foundry use—			
Quantity net tons	1,955,294	755,312	2,710,60
Value	$13,645,407	$3,306,458	$16,951,865
Sold for domestic use—			
Quantity net tons	6,254,382	78,338	6,332,720
Value	$38,959,815	$295,904	$39,255,719
Sold for industrial and other use—			
Quantity net tons	1,318,629	445,745	1,764,374
Value	$8,678,854	$1,715,678	$10,394,532
Disposal of screenings and breeze:			
Used by operator—			
Quantity net tons	3,497,660	29,502	3,527,162
Value	$7,111,311	$28,118	$7,139,429
Sold—			
Quantity net tons	830,135	29,162	859,297
Value	$2,269,945	$51,595	$2,321,540
Average receipts per ton sold:			
Furnace coke (merchant sales)	$5.38	$3.28	$4.22
Foundry coke	$6.98	$4.38	$6.25
Domestic coke	$6.23	$3.78	$6.20
Other industrial coke	$6.58	$3.85	$5.89
Screenings and breeze	$2.73	$1.77	$2.70

[1] Data not available.

TABLE 1.—*Salient statistics of the coke industry in 1928*—Continued

	By-product	Beehive	Total
By-products produced:			
Gas ... M cubic feet	775, 512, 939		775, 512, 939
Wasted ... per cent	2. 4		2. 4
Burned in coking process ... do	39. 0		39. 0
Surplus sold or used ... do	58. 6		58. 6
Tar ... gallons	631, 844, 767		631, 844, 767
Ammonium sulphate or equivalent ... pounds	1, 597, 773, 038		1, 597, 773, 038
Crude light oil ... gallons	188, 597, 956		188, 597, 956
Yield of by-products per ton of coal:			
Gas ... M cubic feet	11. 1		11. 1
Tar ... gallons	9. 0		9. 0
Ammonium sulphate or equivalent ... pounds	22. 8		22. 8
Crude light oil ... gallons	3. 0		3. 0
Value of by-products sold:			
Gas (surplus)	$76, 498, 857		$76, 498, 857
Tar—			
Sold	$17, 544, 797		$17, 544, 797
Used by producer	$15, 883, 808		$15, 883, 808
Ammonium sulphate or equivalent	$27, 340, 056		$27, 340, 056
Crude light oil and derivatives	$28, 879, 807		$28, 879, 807
Other by-products[2]	$1, 046, 011		$1, 046, 011
Total value of coke, breeze, and by-products[3]	$413, 199, 582	$16, 492, 451	$429, 692, 033

[2] Includes naphthalene.

[3] Includes value of tar used by the coke plants.

TABLE 2.—*Statistical trends of the coke industry, 1915, 1923, and 1925–1928*

	1915	1923	1925	1926	1927	1928
Coke produced:						
Beehive ... net tons	27, 508, 255	19, 379, 870	11, 354, 784	12, 488, 951	7, 207, 417	4, 492, 803
By-product ... do	14, 072, 895	37, 597, 664	39, 912, 159	44, 376, 586	43, 884, 726	48, 313, 025
Total ... do	41, 581, 150	56, 977, 534	51, 266, 943	56, 865, 537	51, 092, 143	52, 805, 828
Per cent of total from by-product ovens	33. 8	66. 0	72. 9	78. 0	85. 9	91. 5
Disposal of coke (beehive and by-product):						
Furnace coke (including all coke used by producer) ... net tons	(1)	47, 774, 408	42, 010, 334	45, 019, 560	40, 317, 130	41, 952, 336
Foundry coke ... do	(1)	3, 600, 719	2, 987, 037	3, 331, 677	2, 748, 243	2, 710, 606
Other industrial ... do	(1)	2, 283, 888	2, 645, 584	2, 626, 634	2, 592, 587	1, 764, 374
Domestic coke ... do	(1)	2, 733, 414	4, 477, 766	5, 442, 613	4, 813, 632	6, 332, 720
Number of ovens in existence:						
Beehive	93, 110	62, 349	57, 587	52, 558	49, 795	46, 288
By-product	6, 268	11, 156	11, 290	11, 716	12, 475	12, 544
Number of new by-product ovens under construction at end of year	1, 191	629	429	978	289	145
Cost of coal charged, by-product ovens, average per ton	$2. 33	$4. 76	$3. 86	$3. 88	$3. 87	$3. 57
Prices of coke:						
Average spot price of Connellsville furnace coke f. o. b. ovens	$1. 73	$5. 33	$3. 78	$3. 92	$3. 04	$2. 69
Average realization on by-product coke sold—						
Furnace coke (merchant sales)	(1)	$6. 74	$5. 73	$6. 25	$5. 42	$4. 99
Foundry coke	(1)	$10. 54	$7. 98	$7. 77	$7. 80	$6. 98
Other industrial	(1)	$9. 06	$7. 16	$7. 39	$6. 83	$6. 58
Domestic	(1)	$9. 05	$6. 98	$7. 43	$6. 90	$6. 23
Yield of by-products per ton of coal charged:						
Tar ... gallons	7. 1	8. 1	8. 4	8. 3	8. 6	9. 0
Ammonium sulphate or equivalent ... pounds	20. 1	21. 2	22. 4	21. 7	22. 7	22. 8
Light oil ... gallons	1. 5	2. 7	2. 9	2. 8	2. 9	3. 0
Surplus gas sold or used ... M cu. ft	4. 3	5. 9	6. 3	6. 2	6. 5	6. 5
Average gross receipts of by-products per ton of coke produced:						
Tar sold or used	$0. 25	$0. 51	$0. 59	$0. 60	$0. 66	$0. 69
Ammonia and its compounds	$0. 70	$0. 84	$0. 69	$0. 63	$0. 62	$0. 57
Light oil and its derivatives	$0. 52	$0. 51	$0. 54	$0. 62	$0. 58	$0. 60
Surplus gas sold or used	$0. 61	$1. 37	$1. 54	$1. 46	$1. 60	$1. 58
Total by-products including breeze	$2. 19	$3. 48	$3. 58	$3. 52	$3. 66	$3. 66

[1] No data.

TABLE 3.—*Summary of coke produced, value, number of ovens, coal charged, and average yield, by States, 1927 and 1928*

[Exclusive of screenings and breeze]

State	By-product								Beehive						Total	
	Plants in existence	Ovens		Coal used (net tons)	Yield of coke from coal (per cent)	Coke produced (net tons)	Value of coke at ovens		Ovens	Coal used (net tons)	Yield of coke from coal (per cent)	Coke produced (net tons)	Value of coke at ovens		Coke produced (net tons)	Value of coke at ovens
		Built	Under construction Dec. 31				Total	Per ton					Total	Per ton		
1927																
Alabama	8	1,325	63	6,203,290	70.4	4,364,354	$13,500,234	$3.09	1,831						4,364,354	$13,500,234
Colorado	1	120		867,792	68.5	594,402	(1)	(1)	1,498	299,559	64.8	194,184	(1)	(1)	788,586	(1)
Connecticut			61													
Georgia									151	(2)	(2)	(2)	(2)	(2)	(2)	(2)
Illinois	7	849	101	4,367,337	69.0	3,013,940	21,076,519	6.99							3,013,940	21,076,519
Indiana	7	1,384		7,448,393	74.5	5,549,762	37,152,981	6.69							5,549,762	37,152,981
Kentucky	(2)	(2)		(2)	(2)	(2)	(2)	(2)	763	(2)	(2)	(2)	(2)	(2)	(2)	(2)
Maryland	1	360		1,476,742	73.0	1,077,309	(1)	(1)							1,077,309	(1)
Massachusetts	3	481		1,092,900	68.1	744,091	6,008,556	8.08							744,091	6,008,556
Michigan	6	561		2,693,576	71.3	1,920,394	12,227,241	6.37							1,920,394	12,227,241
Minnesota	3	215	41	919,801	68.8	632,628	6,212,501	9.82							632,628	6,212,501
Missouri	(2)	(2)		(2)	(2)	(2)	(2)	(2)							(2)	(2)
New Jersey	2	207		1,244,627	72.8	906,321	(1)	(1)							906,321	(1)
New Mexico									584							
New York	8	778		5,114,280	70.4	3,602,642	24,125,451	6.70							3,602,642	24,125,451
Ohio	15	1,778		10,470,533	68.9	7,213,619	34,684,465	4.81	204	(2)	(2)	(2)	(2)	(2)	(2)	(2)
Oklahoma									100							
Pennsylvania	12	3,429		16,690,980	66.3	11,061,084	44,601,757	4.03	32,135	8,729,862	65.5	5,716,207	$22,568,318	$3.95	16,777,291	67,170,075
Rhode Island	(2)	(2)		(2)	(2)	(2)	(2)	(2)							(2)	(2)
Tennessee	1	24		162,372	75.3	122,312	612,783	5.01	1,465	185,829	56.4	104,808	536,821	5.12	227,120	1,149,604
Utah	1	33	23	318,367	61.9	197,183	(1)	(1)	819	142,053	59.7	84,865	(1)	(1)	282,048	(1)
Virginia									3,014	528,032	60.0	316,754	1,413,595	4.46	316,754	1,413,595
Washington	1	20		64,926	62.5	40,570	283,990	7.00	332	47,953	64.0	30,701	246,769	8.04	71,271	530,759
West Virginia	4	411		2,065,812	67.6	1,396,285	4,679,048	3.35	6,899	898,043	58.7	527,142	2,161,310	4.10	1,923,427	6,840,358
Wisconsin	(2)	(2)		(2)	(2)	(2)	(2)	(2)							(2)	(2)
Combined States	5	500		2,038,045	71.0	1,447,830	10,624,596	7.34		376,784	61.8	232,756	1,317,756	5.66	8,894,205	46,626,817
Undistributed							16,253,681						2,032,206			18,285,887
	85	12,475	289	63,239,773	69.4	43,884,726	232,043,803	5.29	49,795	11,208,115	64.3	7,207,417	30,276,775	4.20	51,092,143	262,320,578

[1] Included under "Undistributed."

[2] Included under "Combined States."

TABLE 3.—*Summary of coke produced, value, number of ovens, coal charged, and average yield, by States, 1927 and 1928*—Continued

State	By-product								Beehive						Total	
	Plants in existence	Ovens		Coal used (net tons)	Yield of coke from coal (per cent)	Coke produced (net tons)	Value of coke at ovens		Ovens	Coal used (net tons)	Yield of coke from coal (per cent)	Coke produced (net tons)	Value of coke at ovens		Coke produced (net tons)	Value of coke at ovens
		Built	Under construction Dec. 31				Total	Per ton					Total	Per ton		
1928																
Alabama	8	1,388		6,215,804	69.6	4,327,324	$13,260,178	$3.06	953						4,327,324	$13,260,178
Colorado	1	120		891,315	68.0	605,822	(1)	(1)	1,498	220,515	65.4	144,200	(1)	(1)	750,022	(1)
Connecticut	1	61		(2)	(2)	(2)	(2)	(2)							(2)	(2)
Georgia										(2)	(2)	(2)	(2)	(2)	(2)	(2)
Illinois	8	937	21	4,712,289	68.8	3,240,964	19,967,463	6.16							3,240,964	19,967,463
Indiana	7	1,384		8,202,943	74.3	6,094,201	38,237,790	6.27							6,094,201	38,237,790
Kentucky	1	108		(2)	(2)	(2)	(2)	(2)	608	(2)	(2)	(2)	(2)	(2)	(2)	(2)
Maryland	1	360		1,635,668	72.5	1,186,398	(1)	(1)							1,186,398	(1)
Massachusetts	3	381		1,035,336	66.4	687,356	5,269,890	7.67							687,356	5,269,890
Michigan	7	576		3,397,164	70.6	2,399,656	13,461,466	5.61							2,399,656	13,461,466
Minnesota	3	196		899,938	69.2	622,696	5,816,566	9.34							622,696	5,816,566
Missouri	1	64		(2)	(2)	(2)	(2)	(2)							(2)	(2)
New Jersey	2	207		1,252,990	72.1	903,177	(1)	(1)							903,177	(1)
New Mexico									584							
New York	9	868		5,501,162	69.1	3,802,657	25,033,649	6.58							3,802,657	25,033,649
Ohio	16	1,820	15	11,466,044	67.9	7,786,199	33,908,863	4.35	202	(2)	(2)	(2)	(2)	(2)	(2)	(2)
Oklahoma									100							
Pennsylvania	11	3,235	109	20,325,663	66.3	13,475,349	51,132,406	3.79	27,552	5,266,357	65.4	3,442,006	$11,515,366	$3.35	16,917,355	62,647,772
Rhode Island	1	40		(2)	(2)	(2)	(2)	(2)							(2)	(2)
Tennessee	1	24		151,424	74.7	113,134	606,398	5.36	1,415	173,706	59.8	103,791	457,489	4.41	216,925	1,063,887
Utah	1	56		448.350	55.0	246,503	(1)	(1)	819	48,675	57.7	28,097	(1)	(1)	274,600	(1)
Virginia									2,914	420,765	58.9	247,734	1,052,016	4.25	247,734	1,052,016
Washington	1	20		64.458	63.2	40,755	285,285	7.00	235	29.353	63.9	18,747	151,902	8.06	59,502	437,187
West Virginia	4	411		1,966,364	69.5	1,367,481	3,761,460	2.75	4,408	733,504	58.8	431,419	1,543,933	3.58	1,798,900	5,305,393
Wisconsin	2	288		(2)	(2)	(2)	(2)	(2)							(2)	(2)
Combined States				1,998,994	70.7	1,413,353	9,682,047	6.85		125,099	61.4	76,809	406,691	5.29	9,276,361	43,997,601
Undistributed							16,091,743						1,191,159			17,282,902
	89	12,544	145	70,165,906	68.9	48,313,025	236,515,204	4.90	41,288	7,017,974	64.0	4,492,803	16,318,556	3.63	52,805,828	252,833,760

(1) Included under "Undistributed."

(2) Included under "Combined States."

SCOPE OF REPORT

DEFINITIONS OF TERMS USED IN STATISTICAL TABLES

The standard unit of measurement in the coke industry in the United States is the short or net ton of 2,000 pounds; unless other notation is made it is the unit employed throughout this chapter.

The term "coke" does not include breeze or fine coke screenings, because operators in general, especially those in the beehive industry, do not regard this fine material as properly so classified. No effort has been made to define accurately the limitation as to size between coke and breeze. Each operator has followed his own regular practice in reporting his output of fine material to the Bureau of Mines. It is probably safe to say, however, that coke breeze and screenings correspond closely in size to the anthracite usually classified as steam sizes; in other words, they include material smaller than pea coal.

ACCOUNTING PRACTICES OF COKE OPERATORS THAT AFFECT STATISTICS

The term "value" as applied to coke in this report means the value at the ovens. For the part of the output that is sold the value is obviously the amount received for the coke f. o. b. ovens, but a considerable proportion of the coke produced in the United States is made in ovens operated by large corporations that not only mine the coal and make the coke but also have blast furnaces and steel mills that consume the entire product of the ovens. Under such conditions fixing a value upon the coke and upon the coal consumed in making it is purely arbitrary. Some corporations charge the coke to the furnace department at cost; others add a percentage of profit or base the reported value on what the coke would cost if purchased.

These differences in accounting practice also affect the relative proportions of the output reported as "sold" and as "used by producer." Between the blast furnaces, which are the largest users of coke, and the coke plants there is a close business relation that at many plants amounts to identity of ownership. Among such affiliated interests the line between sales and interdepartmental transfers is difficult to draw, and a large part of the furnace coke reported as sold actually goes to iron furnaces that are in some way connected with the coke companies. (See Tables 38 and 39.)

SIX COKE-PRODUCING INDUSTRIES

In the United States coke is produced by a group of six different industries. In addition to that produced in the familiar beehive and by-product ovens coke is obtained in the manufacture of coal gas, in plants carbonizing coal at low temperatures, in the refining of petroleum, and in the distillation of coal tar. The coke produced, however, differs greatly in character, and the problems affecting each of these industries are separate and distinct.

BEEHIVE AND BY-PRODUCT OVEN COKE

Scope of this report—beehive and by-product coke.—Neither petroleum coke, low-temperature coke, nor gas-house coke is adapted for blast-furnace and foundry purposes, the uses that consume the great bulk of all coke produced, and the production of coal-tar coke is so limited as to be of small importance. Practically, therefore, the coke trade is concerned with beehive and by-product oven coke, and the statistics of this report are confined to these two types, except as specifically noted. The dominant position of beehive and by-product coke in the total supply of coke of all kinds is shown by Figure 41. Although their products are interchangeable there are fundamental differences between the beehive and by-product industries which must be kept in mind when the tables in this chapter are examined. The competitive relations between the beehive and by-product industries have been discussed in previous reports of this series and need not be treated here. (See Coke and By-Products in 1924, pp. 666-667.) Market conditions continue to foster the development of by-product coking, and the manufacture of beehive coke assumes more and more the character of an auxiliary agency called upon to furnish only the peak requirements of the metallurgical industry in times of active business.

By-product ovens operated by city gas companies included.—Between the by-product coke and the coal-gas industries the line is increasingly difficult to draw. Adaptation of the by-product coke oven to the needs of city gas manufacture has led a number of gas companies to install batteries of by-product ovens to supplement or even replace their coal or water gas plants. From the point of view of ownership and accounting these installations are a part of the gas utility system, and the Bureau of the Census therefore groups them with the manufactured-gas industry under the title "Gas manufactured, illuminating and heating."

But from other points of view these installations belong to the by-product coke industry. The coke they produce is superior to gas-house coke. In the practical operation of a by-product coke plant the fact that the gas may be distributed through city mains is of less consequence than the fact that the coke must be marketed for foundry, furnace, or household use. Considered with reference to oven design and the technique of manufacture and still more with reference to the supply and demand for coke, they should be included with other by-product coke plants, and they are so included in the statistics published by the Bureau of Mines.

These differences in classification are followed advisedly by the Bureau of the Census and the Bureau of Mines after consultation with leaders of the gas and coke industries, and the two offices have collaborated in the collection and analysis of the statistics. In order to enable the reader to reconcile the two sets of figures and to ascertain the total production of gas and coke from all sources without duplication, tables are given on pages 796 to 798 of this report, in which the production of those by-product ovens operated by city gas companies is shown separately.

GAS-HOUSE COKE

Gas-house coke, like beehive and by-product oven coke, is produced by carbonization of coal at high temperatures. For many years coke produced in horizontal retorts has been a factor in the local fuel market of communities supplied with coal gas. Such retort coke is regarded as a by-product, the primary product being the gas. Because of differences in methods of manufacture and because the coals used are commonly selected for the quality and volume of the gas evolved rather than for their coking properties the coke formed is too soft and friable and too irregular in size and quality for blast-furnace or foundry use. It is, however, suitable for the manufacture of water gas, a fact that has led many gas companies to combine water-gas machines and coal-gas retorts in the same plant. For many years between a third or a half of the gas-house coke produced has been used for making water gas, for heating retorts, or for boiler fuel about the plant where it was made. The remainder was disposed of as domestic fuel in the local market.

Recent years have witnessed an improvement in the quality of gas-house coke in many communities. Greater care has been exercised in screening and sizing the product, and numerous installations of horizontal retorts have been replaced with continuous vertical retorts or with small horizontal gas ovens resembling miniature coke ovens.[2] The total production of gas-house coke in 1927, the latest year for which accurate figures are available, was 2,845,189 tons, of which 1,484,268 tons was sold, presumably for domestic use. (See Table 4.) This includes not only coke from horizontal retorts but also from all other types of high-temperature carbonizing equipment except coke ovens. A considerable proportion of this, beyond doubt, represents small horizontal-oven coke.

TABLE 4.—*Gas-house coke produced and sold in the United States, 1915–1927*

[Figures include coke made in all types of high-temperature carbonizing equipment other than coke ovens]

Year	Production (net tons)	Sales (net tons)	Value of sales	
			Total	Average per net ton
1915[1]	2,940,926	1,662,552	$7,198,377	$4.33
1917[1]	3,094,966	1,857,248	10,953,693	5.90
1918[1]	3,180,535	1,813,740	13,963,232	7.70
1919[2]	3,035,570	1,485,758	(3)	(3)
1920[1]	3,137,332	1,378,537	11,638,525	8.44
1921[2]	3,159,490	1,586,728	(3)	(3)
1922[1]	2,877,787	1,387,658	12,032,244	8.67
1923[2]	2,779,993	1,438,463	(3)	(3)
1924	(3)	[4]1,400,000	(3)	(3)
1925[2]	2,907,018	1,368,704	(3)	(3)
1926	(3)	[4]1,400,000	(3)	(3)
1927[2]	2,845,189	1,484,268	(3)	(3)

[1] Reported by the gas companies direct to the U. S. Geological Survey.

[2] Obtained by subtracting from the total for all manufactured-gas plants (public utilities) as reported by the Census of Manufactures the figures reported to the Bureau of Mines for those by-product coke plants that are counted by the census as a part of the manufactured-gas industry. See Table 99, p.797, for a recapitulation of the operations of these by-product plants.

[3] No data.

[4] Estimated by interpolation.

LOW-TEMPERATURE COKE

In the United States, as elsewhere, much experimental work has been done in the field of low-temperature carbonization of coal, but in 1928 the quantity of coke produced by low-temperature methods was insignificant.

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[2] McBride, R. S., Miniature Coke Ovens to Serve the Small Community: Am. Gas Jour., July, 1927, pp. 27–31.

The year was notable, however, for the construction at New Brunswick, N. J., of what is reported to be the largest low-temperature carbonization plant in the world. The plant has an annual capacity of 250,000 tons of coal and uses the KSG process, which takes its name from the Kohlenscheidungs-Gesellschaft, a subsidiary of International Combustion Engineering Co. The company's original plant near Essen, Germany, is said to have operated for five years.

As the New Brunswick plant did not begin operation until 1929, discussion is reserved for a later report. The development is being watched with great interest by all concerned with the processing of coal as the first large-scale test of low-temperature carbonization under the conditions prevailing in the United States.

PETROLEUM COKE

When the refining of crude oil is conducted at temperatures above that of decomposition an ultimate residue is left known as petroleum coke. Its physical properties are much like those of coke made from coal, except that it is finer in texture, lacks the strength required for blast-furnace or foundry coke, and is extraordinarily low in ash, probably averaging not more than 1.5 per cent. In 1928 the total production of petroleum coke amounted to 1,426,000 tons. Because of its extremely low ash content petroleum coke is in demand as a source of comparatively pure carbon and is widely used in the manufacture of carbon electrodes, electric-furnace resisters, and dry cells. The rest of the output is disposed of locally, either for miscellaneous purposes or for domestic fuel. According to a special study by E. B. Swanson, of the Bureau of Mines, the quantity sold for domestic use in 1928 was 235,000 tons. The total production of petroleum coke in recent years, as reported by G. R. Hopkins, of the bureau, is shown in Table 5.

Table 5.—*Petroleum coke produced and in stock in the United States, 1918–1928, in net tons*

Year	Production	Stock at end of year	Year	Production	Stock at end of year
1918	559, 663	22, 605	1924	761, 095	97, 844
1919	603, 459	21, 146	1925	990, 991	238, 403
1920	576, 613	31, 469	1926	995, 308	290, 582
1921	604, 465	74, 508	1927	1, 145, 200	345, 100
1922	707, 064	35, 722	1928	1, 426, 000	436, 900
1923	672, 526	26, 264			

COAL-TAR COKE

Recent developments have made available another form of coke—that derived from coal-tar pitch. The product, which is known as pitch coke, is not to be confused with the tar-still coke, sometimes obtained as the end product of the distillation of tar. Tar-still coke is too soft for metallurgical use and is of relatively small value; for this and other reasons it is common practice to run the pitch out of the stills before it reaches the stage of coking. By introducing the pitch into a coke oven, however, and by coking it an excellent metallurgical coke may be produced, unusually hard and firm, containing only 0.3 per cent of ash, and very low in sulphur. Pitch coke has proved itself well adapted to foundry use and often commands a premium over coke made from coal. The manufacture of pitch coke is established commercially but has not yet reached the stage where publication of statistics on the subject is expedient.

COKE AND COKE BREEZE

GROWTH OF INDUSTRY

TABLE 6.—*By-product and beehive coke produced in the United States, 1880–1928, in net tons*

Year	By-product	Beehive	Total	Year	By-product	Beehive	Total
1880		3,338,300	3,338,300	1905	3,462,348	28,768,781	32,231,129
1881		4,113,760	4,113,760	1906	4,558,127	31,843,090	36,401,217
1882		4,793,321	4,793,321	1907	5,607,899	35,171,665	40,779,564
1883		5,464,721	5,464,721	1908	4,201,226	21,832,292	26,033,518
1884		4,873,805	4,873,805	1909	6,254,644	33,060,421	39,315,065
1885		5,106,696	5,106,696	1910	7,138,734	34,570,076	41,708,810
1886		6,845,369	6,845,369	1911	7,847,845	27,703,644	35,551,489
1887		7,611,705	7,611,705	1912	11,115,164	32,868,435	43,983,599
1888		8,540,030	8,540,030	1913	12,714,700	33,584,830	46,299,530
1889		10,258,022	10,258,022	1914	11,219,943	23,335,971	34,555,914
1890		11,508,021	11,508,021	1915	14,072,895	27,508,255	41,581,150
1891		10,352,688	10,352,688	1916	19,069,361	35,464,224	54,533,585
1892		12,010,829	12,010,829	1917	22,439,280	33,167,548	55,606,828
1893	12,850	9,464,730	9,477,580	1918	25,997,580	30,480,792	56,478,372
1894	16,500	9,187,132	9,203,632	1919	25,137,621	19,042,936	44,180,557
1895	18,521	13,315,193	13,333,714	1920	30,833,951	20,511,092	51,345,043
1896	83,038	11,705,735	11,788,773	1921	19,749,580	5,538,042	25,287,622
1897	261,912	13,027,072	13,288,984	1922	28,550,545	8,573,467	37,124,012
1898	294,445	15,752,764	16,047,209	1923	37,597,664	19,379,870	56,977,534
1899	906,534	18,762,035	19,668,569	1924	33,983,568	10,286,037	44,269,605
1900	1,075,727	19,457,621	20,533,348	1925	39,912,159	11,354,784	51,266,943
1901	1,179,900	20,615,983	21,795,883	1926	44,376,586	12,488,951	56,865,537
1902	1,403,588	23,998,142	25,401,730	1927	43,884,726	7,207,417	51,092,148
1903	1,882,394	23,391,887	25,274,281	1928	48,313,025	4,492,803	52,805,828
1904	2,608,229	21,052,877	23,661,106				

TABLE 7.—*Concise statistical summary illustrating growth of the coke industry in the United States, 1880–1928*

Year	Production (million net tons)			Per cent of total production from by-product ovens	Number of ovens in existence		Number of by-product ovens under construction at end of year	Coal charged (million net tons)	Yield of coke from coal (per cent)	Average value of coke per ton at plant	Total value at plant (million dollars)			
	By-product	Beehive	Total		By-product	Beehive					Beehive coke	By-product coke	All by-products[1]	Total coke and by-products
1880		3.3	3.3			12,372		5.2	63.7	$1.99	7			7
1881		4.1	4.1			14,119		6.5	62.8	1.88	8			8
1882		4.8	4.8			16,356		7.6	63.3	1.77	8			8
1883		5.5	5.5			18,304		8.5	64.2	1.49	8			8
1884		4.9	4.9			19,557		8.0	61.3	1.49	7			7
1885		5.1	5.1			20,116		8.1	63.3	1.49	8			8
1886		6.8	6.8			22,597		10.7	64.0	1.63	11			11
1887		7.6	7.6			26,001		11.9	64.2	2.01	15			15
1888		8.5	8.5			30,059		12.9	66.0	1.46	12			12
1889		10.3	10.3			34,165		16.0	64.3	1.62	17			17
1890		11.5	11.5			37,158		18.0	63.9	2.02	23			23
1891		10.4	10.4			40.057		16.3	63.3	1.97	20			20
1892		12.0	12.0			42,002		18.8	63.8	1.96	24			24
1893	0.01	9.5	9.5	0.1	12	44,189		14.9	63.5	1.74	17		[2]	[2]
1894	.02	9.2	9.2	.2	12	44,760	60	14.4	64.0	1.34	12		[2]	[2]

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[1] The value for tar up to and including 1917 represented that of the tar "obtained and sold," which did not always include the value of tar used by the producer. Beginning with 1918, tar used by the producer is specifically included. The value of breeze produced at by-product plants is included for those years for which it was reported, namely, 1916, 1917, and 1919–1928. The value of breeze produced at beehive plants is not included, as it has usually been much less than a million dollars.

[2] No accurate data on the value of the by-products available.

TABLE 7.—*Concise statistical summary illustrating growth of the coke industry in the United States, 1880–1928*—Continued

Year	Production (million net tons)			Per cent of total production from by-product ovens	Number of ovens in existence		Number of by-product ovens under construction at end of year	Coal charged (million net tons)	Yield of coke from coal (per cent)	Average value of coke per ton at plant	Total value at plant (million dollars)			
	By-product	Beehive	Total		By-product	Beehive					Beehive coke	By-product coke	All by-products	Total coke and by-products
1895	0.02	13.3	13.3	0.1	72	45,493	60	20.8	64.0	$1.44	19		(2)	(2)
1896	.1	11.7	11.8	.7	160	46,784	120	18.7	63.1	1.84	22		(2)	(2)
1897	.3	13.0	13.3	2.0	280	47,388	240	20.9	63.6	1.66	22		(2)	(2)
1898	.3	15.7	16.0	1.8	520	47,863	500	25.2	63.6	1.59	26		(2)	(2)
1899	.9	18.8	19.7	4.6	1,020	48,583	65	30.2	65.1	1.76	35		(2)	(2)
1900	1.1	19.4	20.5	5.2	1,085	57,399	1,096	32.1	63.9	2.31	47		(2)	(2)
1901	1.2	20.6	21.8	5.4	1,165	62,786	1,533	34.2	63.7	2.04	44		------	------
1902	1.4	24.0	25.4	5.5	1,663	67,406	1,346	39.6	64.1	2.49	63		(2)	(2)
1903	1.9	23.4	25.3	7.4	1,956	77,378	1,335	39.4	64.1	2.63	66		(2)	(2)
1904	2.6	21.1	23.7	11.0	2,910	80,689	832	36.5	64.8	1.95	46		(2)	(2)
1905	3.4	28.8	32.2	10.7	3,103	84,405	417	49.5	65.1	2.25	72		(2)	(2)
1906	4.6	31.8	36.4	12.5	3,547	90,354	112	55.7	65.3	2.52	92		(2)	(2)
1907	5.6	35.2	40.8	13.8	3,684	95,996	330	61.9	65.8	2.74	90	22	8	120
1908	4.2	21.8	26.0	16.1	3,799	97,419	240	39.4	66.0	2.40	48	14	7	69
1909	6.2	33.1	39.3	15.9	3,989	99,993	949	59.4	66.2	2.29	70	20	8	98
1910	7.1	34.6	41.7	17.1	4,078	100,362	1,200	63.1	66.1	2.39	75	25	8	108
1911	7.9	27.7	35.6	22.1	4,624	99,255	698	53.3	66.7	2.37	57	27	10	94
1912	11.1	32.9	44.0	25.3	5,211	97,019	793	65.6	67.1	2.54	69	43	14	126
1913	12.7	33.6	46.3	27.5	5,688	96,962	504	69.2	66.9	2.78	80	49	17	146
1914	11.2	23.4	34.6	32.5	5,809	93,946	644	51.6	66.9	2.56	50	38	18	106
1915	14.1	27.5	41.6	33.8	6,268	93,110	1,191	61.8	67.2	2.54	57	49	30	136
1916	19.1	35.4	54.5	35.0	7,283	91,581	2,084	81.6	66.8	3.13	96	75	62	233
1917	22.4	33.2	55.6	40.4	7,869	88,027	2,260	83.8	66.4	5.36	159	139	68	366
1918	26.0	30.5	56.5	46.0	9,279	84,635	1,815	85.0	66.4	6.77	189	193	77	459
1919	25.1	19.1	44.2	56.9	10,379	82,560	877	65.6	67.4	5.85	98	160	68	326
1920	30.8	20.5	51.3	60.0	10,881	75,298	396	76.2	67.4	9.27	163	313	105	581
1921	19.8	5.5	25.3	78.1	11,142	66,014	85	37.2	68.0	5.84	30	118	68	216
1922	28.5	8.6	37.1	76.9	11,212	63,958	403	54.3	68.3	6.42	50	188	95	333
1923	37.6	19.4	57.0	66.0	11,156	62,349	629	84.4	67.5	6.56	116	257	131	504
1924	34.0	10.3	44.3	76.8	11,413	60,432	247	65.0	68.1	5.51	48	196	120	364
1925	39.9	11.4	51.3	77.9	11,290	57,587	429	74.5	68.8	5.12	52	211	143	402
1926	44.4	12.5	56.9	78.0	11,716	52,558	978	82.9	68.6	5.41	57	251	157	466
1927	43.9	7.2	51.1	85.9	12,475	49,795	289	74.4	68.6	5.13	30	232	160	425
1928	48.3	4.5	52.8	91.5	12,544	41,288	145	77.2	68.4	4.79	16	237	177	430

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[2] No accurate data on the value of the by-products available.

MONTHLY AND WEEKLY PRODUCTION

Figures for monthly and weekly production of coke are given in Tables 8 to 11. The monthly statistics of by-product coke are based on reports from the producers themselves.

The current statistics of beehive coke are estimates based on reports of cars of coke loaded for shipment by the principal coke-carrying roads. The reports are now received weekly and are here shown adjusted to a monthly basis. As beehive coke is ordinarily not stored at the ovens in any great quantity, the shipments are an excellent indicator of weekly production. The estimates also allow for shipments over the Monongahela River and other waterways and over private railroads and for amounts consumed by associated steelworks close to the ovens.

The estimates thus obtained are published currently in the weekly coal reports of the Bureau of Mines. At the end of the year, if the total of the current estimates does not exactly equal the actual production as reported to the bureau by the operators, an adjustment in the current figures is made. The data in the accompanying tables have been revised in this way.

TABLE 8.—*By-product, beehive, and total coke produced in the United States, 1925–1928, by months, and average per day, in net tons*

Month	1925		1926		1927		1928	
	Total	Daily average	Total	Daily average	Total	Daily average	Total	Daily average
By-product:								
January	3,404,000	109,800	3,796,000	122,500	3,706,000	119,500	3,906,000	126,000
February	3,118,000	111,600	3,492,000	124,700	3,429,000	122,500	3,731,000	128,700
March	3,449,000	111,300	3,772,000	121,700	3,876,000	125,000	4,074,000	131,400
April	3,308,000	110,300	3,604,000	120,100	3,705,000	123,500	3,934,000	131,100
May	3,280,000	105,800	3,725,000	120,200	3,785,000	122,100	4,109,000	132,500
June	3,151,000	105,000	3,614,000	120,500	3,594,000	119,800	3,970,000	132,300
July	3,167,000	102,200	3,771,000	121,600	3,655,000	117,900	3,920,000	126,400
August	3,159,000	101,900	3,742,000	120,700	3,677,000	118,600	4,004,000	129,200
September	3,178,000	105,900	3,640,000	121,300	3,601,000	120,000	3,967,000	132,300
October	3,395,000	109,500	3,799,000	122,500	3,717,000	119,900	4,229,000	136,400
November	3,550,000	118,300	3,730,000	124,300	3,497,000	116,600	4,142,000	138,100
December	3,753,000	121,100	3,692,000	119,100	3,643,000	117,500	4,327,000	139,600
	39,912,000	109,300	44,377,000	121,600	43,885,000	120,200	48,313,000	132,000
Beehive:								
January	1,241,000	46,000	1,500,000	57,700	810,000	31,200	385,000	14,800
February	1,117,000	46,500	1,524,000	63,500	776,000	32,300	400,000	16,000
March	1,066,000	41,000	1,259,000	46,600	916,000	33,900	459,000	17,100
April	854,000	32,800	1,068,000	41,100	802,000	30,800	387,000	15,500
May	710,000	27,300	964,000	37,100	648,000	24,900	386,000	14,300
June	632,000	24,300	882,000	33,900	596,000	22,900	311,000	11,900
July	561,000	21,600	856,000	32,900	480,000	19,200	280,000	11,200
August	641,000	24,700	818,000	31,500	500,000	18,500	297,000	10,900
September	794,000	30,500	892,000	34,300	470,000	18,100	322,000	12,800
October	1,068,000	39,600	943,000	36,300	431,000	16,600	431,000	16,000
November	1,286,000	51,400	935,000	36,000	390,000	15,000	427,000	16,400
December	1,385,000	53,300	848,000	32,600	388,000	14,900	408,000	16,300
	11,355,000	36,500	12,489,000	40,200	7,207,000	23,200	4,493,000	14,400
Total coke:								
January	4,645,000	155,800	5,296,000	180,200	4,516,000	150,700	4,291,000	140,800
February	4,235,000	158,100	5,016,000	188,200	4,205,000	154,800	4,131,000	144,700
March	4,515,000	152,300	5,031,000	168,300	4,792,000	158,900	4,533,000	148,500
April	4,162,000	143,100	4,672,000	161,200	4,507,000	154,300	4,321,000	146,600
May	3,990,000	133,100	4,689,000	157,300	4,433,000	147,000	4,495,000	146,800
June	3,783,000	129,300	4,496,000	154,400	4,190,000	142,700	4,281,000	144,200
July	3,728,000	123,800	4,627,000	154,500	4,135,000	137,100	4,200,000	137,600
August	3,800,000	126,600	4,560,000	152,200	4,177,000	137,100	4,301,000	140,100
September	3,972,000	136,400	4,532,000	155,600	4,071,000	138,100	4,289,000	145,100
October	4,463,000	149,100	4,742,000	158,800	4,148,000	136,500	4,660,000	152,400
November	4,836,000	169,700	4,665,000	160,300	3,887,000	131,600	4,569,000	154,500
December	5,138,000	174,400	4,540,000	151,700	4,031,000	132,400	4,735,000	155,900
	51,267,000	145,800	56,866,000	161,800	51,092,000	143,400	52,806,000	146,400

TABLE 9.—*Coke shipped from the Connellsville and Lower Connellsville districts, Pennsylvania, 1921–1928, by months, in net tons*[1]

Month	1921	1922	1923	1924	1925	1926	1927	1928
January	735,897	377,003	1,046,630	937,790	904,110	1,004,330	570,720	221,200
February	552,568	397,537	1,048,425	921,070	795,690	934,060	552,150	222,550
March	361,646	584,497	1,292,435	1,024,770	785,080	856,600	630,990	299,400
April	198,966	377,433	1,270,355	800,420	583,740	756,170	579,330	261,000
May	186,256	247,145	1,342,545	504,740	349,400	672,550	468,340	218,060
June	130,324	276,304	1,306,750	303,370	325,800	602,690	401,310	185,570
July	92,880	283,472	1,196,660	243,090	265,780	555,440	302,280	130,380
August	158,250	371,499	1,144,790	205,430	414,510	545,850	306,000	137,560
September	188,664	451,240	1,005,200	263,520	513,590	603,680	273,290	145,660
October	257,499	628,333	914,800	329,430	673,920	642,310	222,280	260,470
November	303,532	799,087	781,690	451,950	830,460	609,010	187,320	269,010
December	405,935	872,950	754,060	668,980	953,040	559,640	187,690	254,090
	3,572,417	5,666,500	13,104,340	6,654,560	7,395,120	8,342,330	4,681,700	2,604,950

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[1] From the Connellsville Courier.

TABLE 10.—*Beehive coke produced in the United States in 1928, by weeks*

[Estimated from railroad shipments]

Week ended—	Net tons	Week ended—	Net tons	Week ended—	Net tons
Jan. 7	86,000	May 19	83,000	Sept. 29	81,800
Jan. 14	92,300	May 26	84,300	Oct 6	83,800
Jan. 21	86,300	June 2	75,200	Oct. 13	93,000
Jan. 28	91,100	June 9	74,200	Oct. 20	101,800
Feb. 4	90,900	June 16	69,600	Oct. 27	103,000
Feb. 11	94,100	June 23	69,100	Nov. 3	105,300
Feb. 18	98,000	June 30	71,700	Nov. 10	107,600
Feb. 25	98,300	July 7	61,200	Nov. 17	101,400
Mar. 3	99,600	July 14	72,200	Nov. 24	94,900
Mar. 10	103,200	July 21	63,600	Dec. 1	88,200
Mar. 17	102,200	July 28	60,900	Dec. 8	97,500
Mar. 24	102,600	Aug. 4	61,500	Dec. 15	95,600
Mar. 31	103,600	Aug. 11	60,300	Dec. 22	90,400
Apr. 7	94,600	Aug. 18	69,700	Dec. 29	85,700
Apr. 14	93,600	Aug. 25	69,700	Dec. 31[1]	16,200
Apr. 21	89,100	Sept. 1	68,700		
Apr. 28	94,400	Sept. 8	74,400		4,492,800
May 5	94,800	Sept. 15	75,200		
May 12	89,500	Sept. 22	77,900		

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[1] 1 day only.

TABLE 11.—*By-product coke produced in the United States in 1928, by months and by States, in net tons* [1]

State	January	February	March	April	May	June	July
Alabama	380,000	358,000	387,000	355,000	362,000	353,000	335,000
Colorado	52,000	49,000	52,000	49,000	52,000	50,000	51,000
Illinois	279,000	276,000	305,000	271,000	276,000	272,000	223,000
Indiana	492,000	525,000	563,000	538,000	560,000	524,000	490,000
Maryland	101,000	85,000	104,000	99,000	102,000	98,000	99,000
Massachusetts	61,000	57,000	62,000	54,000	43,000	54,000	55,000
Michigan	175,000	175,000	184,000	182,000	209,000	198,000	203,000
Minnesota	53,000	48,000	51,000	49,000	52,000	50,000	52,000
New Jersey	78,000	72,000	77,000	74,000	75,000	73,000	76,000
New York	316,000	280,000	308,000	302,000	317,000	304,000	315,000
Ohio	578,000	548,000	605,000	617,000	656,000	639,000	670,000
Pennsylvania	1,079,000	1,013,000	1,124,000	1,108,000	1,151,000	1,095,000	1,085,000
Tennessee	10,000	10,000	10,000	10,000	10,000	10,000	9,000
Utah	15,000	18,000	18,000	21,000	21,000	20,000	21,000
Washington	4,000	3,000	3,000	3,000	3,000	3,000	4,000
West Virginia	110,000	102,000	110,000	96,000	109,000	118,000	121,000
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	123,000	112,000	111,000	106,000	111,000	109,000	111,000
	3,906,000	3,731,000	4,074,000	3,934,000	4,109,000	3,970,000	3,920,000

State	August	September	October	November	December	Total
Alabama	331,000	324,000	370,000	371,000	401,000	4,427,000
Colorado	50,000	49,000	51,000	50,000	51,000	606,000
Illinois	221,000	259,000	281,000	284,000	294,000	3,241,000
Indiana	493,000	478,000	488,000	456,000	487,000	6,094,000
Maryland	95,000	100,000	105,000	99,000	99,000	1,186,000
Massachusetts	55,000	55,000	62,000	63,000	66,000	687,000
Michigan	210,000	206,000	220,000	214,000	224,000	2,400,000
Minnesota	52,000	50,000	53,000	55,000	58,000	623,000
New Jersey	77,000	73,000	76,000	74,000	78,000	903,000
New York	318,000	314,000	330,000	338,000	361,000	3,803,000
Ohio	680,000	675,000	711,000	686,000	721,000	7,786,000
Pennsylvania	1,152,000	1,115,000	1,203,000	1,163,000	1,187,000	13,475,000
Tennessee	8,000	8,000	8,000	10,000	10,000	113,000
Utah	22,000	21,000	23,000	23,000	24,000	247,000
Washington	4,000	3,000	4,000	3,000	4,000	41,000
West Virginia	125,000	122,000	119,000	116,000	120,000	1,368,000
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	111,000	115,000	125,000	137,000	142,000	1,413,000
	4,004,000	3,967,000	4,229,000	4,142,000	4,327,000	48,313,000

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[1] Based upon reports from all producers.

PRODUCTION BY FURNACE AND NONFURNACE PLANTS

Tables 12 to 14 give the production of by-product coke by plants associated with iron furnaces and by other plants.

The terms "furnace" and "merchant" operators originated in the Connellsville beehive-coke trade. As the name implies, the beehive-furnace interests are those affiliated with the producers of iron and steel and whose output does not ordinarily enter the open market. In the by-product industry, however, it is not always easy to classify a particular plant. There are by-product plants financially affiliated with iron furnaces, in which the bulk of the product is nevertheless foundry and domestic coke which must be sold on the competitive market. There have been other plants—entirely independent of iron furnaces in point of ownership—that nevertheless were operated under contract to produce furnace coke exclusively for an adjacent ironworks.

A "furnace" plant is now defined as one that has for its main business the production of furnace coke and that has an assured outlet for its furnace coke either through financial affiliation with or direct ownership by an ironworks, or through long-time contracts.

Under this definiton the class of "other" plants includes a few plants affiliated with local iron furnaces but producing much more coke than the furnaces can absorb and therefore depending chiefly on the foundry and domestic trade or on merchant sales of furnace coke. It also includes merchant producers of furnace coke who have to sell their output on the competitive market; it includes the plants affiliated with alkali works; it includes all those operated as gas utilities; and it includes the growing number of plants, that, though not public utilities, have been constructed primarily to supply city gas and that must sell their coke where they can for domestic and industrial as well as metallurgical use. Because of the miscellaneous character of this group of plants, it is thought best to designate them not as "merchant" but as "nonfurnace" or "other" plants. The classification assigned to each plant in the country is indicated in Table 23 under the column "Type of plant."

TABLE 12.—*Number and production of by-product coke plants connected with iron furnaces and of other by-product plants, 1913–1928*

Year	Number of active plants		Coke produced (net tons)		Percentage of production	
	Furnace plants	Other plants	Furnace plants	Other plants	Furnace plants	Other plants
1913	20	16	9, 277, 832	3, 436, 868	73. 0	27. 0
1914	22	15	7, 832, 950	3, 386, 993	69. 8	30. 2
1915	23	17	10, 206, 434	3, 866, 461	72. 5	27. 5
1916	28	18	14, 006, 214	5, 063, 147	73. 4	26. 6
1917	31	21	16, 607, 870	5, 831, 410	74. 0	26. 0
1918	36	24	19, 220, 342	6, 777, 238	73. 9	26. 1
1919	40	25	19, 135, 587	6, 002, 034	76. 1	23. 9
1920	42	26	24, 257, 128	6, 576, 823	78. 7	21. 3
1921	42	25	15, 878, 899	3, 870, 681	80. 4	19. 6
1922	39	25	22, 850, 186	5, 700, 359	80. 0	20. 0
1923	40	25	29, 660, 369	7, 937, 295	78. 9	21. 1
1924	42	29	26, 919, 283	7, 064, 285	79. 2	20. 8
1925	43	31	31, 494, 030	8, 418, 129	78. 9	21. 1
1926	43	35	34, 714, 462	9, 662, 124	78. 2	21. 8
1927	44	35	34, 110, 858	9, 773, 868	77. 7	22. 3
1928	46	39	38, 244, 254	10, 068, 771	79. 2	20. 8

TABLE 13.—*Monthly and average daily production of by-product coke by plants associated with iron furnaces and by all other plants, 1926–1928, in net tons*

	1926		1927		1928	
	Furnace plants	Other plants	Furnace plants	Other plants	Furnace plants	Other plants
Monthly production:						
January	2,974,000	822,000	2,879,000	827,000	3,048,000	858,000
February	2,693,000	799,000	2,675,000	754,000	2,945,000	786,000
March	2,942,000	830,000	3,040,000	836,000	3,236,000	838,000
April	2,826,000	778,000	2,939,000	766,000	3,129,000	805,000
May	2,921,000	804,000	3,003,000	782,000	3,289,000	820,000
June	2,828,000	786,000	2,812,000	782,000	3,157,000	813,000
July	2,979,000	792,000	2,818,000	837,000	3,122,000	798,000
August	2,943,000	799,000	2,832,000	845,000	3,199,000	805,000
September	2,851,000	789,000	2,772,000	829,000	3,133,000	834,000
October	2,971,000	828,000	2,856,000	861,000	3,346,000	883,000
November	2,918,000	812,000	2,688,000	809,000	3,257,000	885,000
December	2,869,000	823,000	2,797,000	846,000	3,383,000	944,000
	34,715,000	9,662,000	34,111,000	9,774,000	38,244,000	10,069,000
Average daily production:						
January	96,000	27,000	92,900	26,600	98,300	27,700
February	96,000	29,000	95,600	26,900	101,600	27,100
March	95,000	27,000	98,000	27,000	104,400	27,000
April	94,000	26,000	98,000	25,500	104,300	26,800
May	94,000	26,000	96,900	25,200	106,100	26,400
June	94,000	26,000	93,700	26,100	105,200	27,100
July	96,000	26,000	90,900	27,000	100,700	25,700
August	95,000	26,000	91,300	27,300	103,200	26,000
September	95,000	26,000	92,400	27,600	104,500	27,800
October	96,000	27,000	92,100	27,800	107,900	28,500
November	97,000	27,000	89,600	27,000	108,600	29,500
December	92,000	27,000	90,200	27,300	109,100	30,500
Average	95,000	26,000	93,400	26,800	104,500	27,500

TABLE 14.—*Percentage of total monthly output of by-product coke produced by plants associated with iron furnaces and by other plants, 1925–1928*

Month	1925		1926		1927		1928	
	Furnace plants	Other plants	Furnace plants	Other plants	Furnace plants	Other plants	Furnace plants	Other plants
January	80.7	19.3	78.3	21.7	77.7	22.3	78.0	22.0
February	79.4	20.6	77.1	22.9	78.0	22.0	78.9	21.1
March	79.4	20.6	78.0	22.0	78.4	21.6	79.4	20.6
April	79.5	20.5	78.4	21.6	79.3	20.7	79.5	20.5
May	79.0	21.0	78.4	21.6	79.3	20.7	80.0	20.0
June	78.9	21.1	78.3	21.7	78.2	21.8	79.5	20.5
July	78.2	21.8	79.0	21.0	77.1	22.9	79.6	20.4
August	77.7	22.3	78.7	21.3	77.0	23.0	79.9	20.1
September	78.1	21.9	78.3	21.7	77.0	23.0	79.0	21.0
October	78.1	21.9	78.2	21.8	76.8	23.2	79.1	20.9
November	79.1	20.9	78.2	21.8	76.9	23.1	78.6	21.4
December	78.8	21.2	77.7	22.3	76.8	23.2	78.2	21.8
Average	78.9	21.1	78.2	21.8	77.7	22.3	79.2	20.8

PRODUCTION BY STATES AND DISTRICTS

TABLE 15.—*Rank of States in the production of coke in 1928 and highest recorded production*

State	Rank in 1928	Net tons, 1928	Maximum production	
			Year	Net tons
Pennsylvania	1	16,917,355	1916	31,279,695
Ohio	2	[1]7,786,199	[1]1928	[1]7,786,199
Indiana	3	6,094,201	1928	6,094,201
Alabama	4	4,327,324	1917	4,892,589
New York	5	3,802,657	1928	3,802,657
Illinois	6	3,240,964	1926	3,336,962
Michigan	7	2,399,656	1928	2,399,656
West Virginia	8	1,798,900	1907	4,112,896
Maryland	9	1,186,398	1928	1,186,398
New Jersey	10	903,177	1926	913,250
Colorado	11	750,022	1906	1,455,905
Massachusetts	12	687,356	1927	744,091
Minnesota	13	622,696	1918	784,065
Wisconsin	14	(2)	1918	(2)
Kentucky	15	(2)	1917	863,071
Utah	16	274,600	1925	314,159
Virginia	17	247,734	1906	1,577,659
Missouri	18	(2)	1923	(2)
Tennessee	19	216,925	1902	560,006
Rhode Island	20	(2)	1923	(2)
Connecticut	21	(2)	[3]1928	(2)
Washington	22	59,502	1916	534,653
Georgia	23	(2)	1891	103,057
New Mexico[4]	-------	-------	1918	597,072
Oklahoma[4]	-------	-------	[5]1905	[5]54,781
Kansas[4]	-------	-------	[5]1902	[5]20,902
Montana[4]	-------	-------	[5]1897	[5]67,849
Wyoming[4]	-------	-------	[5]1897	[5]24,007
Texas[4]	-------	-------	[5]1897	[5]394

[1] By-product coke only. Beehive coke can not be shown without disclosing individual operations.

[2] Can not be shown without disclosing individual operations.

[3] Began production in 1928.

[4] 6 States which formerly produced coke have dropped out of the list of producers. New Mexico last produced in 1926, Oklahoma in 1910, Kansas in 1912, Montana in 1911, Wyoming in 1906, Texas in 1897.

[5] Figures represent maximum year that can be published without disclosing individual operations.

TABLE 16.—*By-product and beehive coke produced, by States, 1918 and 1925–1928, in net tons*

State	1918	1925	1926	1927	1928
By-product:					
Alabama	2,634,451	4,582,153	4,779,986	4,364,354	4,327,324
Colorado	230,663	489,657	592,939	594,402	605.822
Connecticut	-------	-------	-------	-------	(1)
Illinois	2,285,610	3,011,497	3,336,962	3,013,940	3,240,964
Indiana	3,898,215	5,141,940	5,990,344	5,549,762	6,094,201
Kentucky	517,749	(1)	(1)	(1)	(1)
Maryland	474,368	1,019,209	1,120,610	1,077,309	1,186,398
Massachusetts	556,397	535,302	573,748	744,091	687,356
Michigan	(1)	1,751,118	1,826,638	1,920,394	2,399,656
Minnesota	784,065	518,355	619,905	632,628	622,696
Missouri	(1)	(1)	(1)	(1)	(1)
New Jersey	682,148	903,997	913,250	906,321	903,177
New York	1,069,587	2,219,409	2,827,805	3,602,642	3,802,657
Ohio	5,226,334	7,105,129	7,547,836	7,213,619	7,786,199
Pennsylvania	4,586,981	9,853,262	11,200,624	11,061,084	13,475,349
Rhode Island	-------	(1)	(1)	(1)	(1)
Tennessee	124,469	88,879	118,624	122,312	113,134
Utah	-------	168,150	184,756	197,183	246,503
Washington	30,129	40,757	42,584	40,570	40,755
West Virginia	603,393	1,055,992	1,129,862	1,396,285	1,367,481
Wisconsin	(1)	(1)	(1)	(1)	(1)
Combined States	2,293,021	1,427,353	1,570,113	1,447,830	1,413,353
	25,997,580	39,912,159	44,376,586	43,884,726	48,313,025

[1] Included under "Combined States."

TABLE 16.—*By-product and beehive coke produced, by States, 1918 and 1925–1928, in net tons*—Continued

State	1918	1925	1926	1927	1928
Beehive:					
Alabama	1,717,721	88,328	(1)	----------	----------
Colorado	758,784	154,824	197,179	194,184	144,200
Georgia	22,048	4,925	3,059	(1)	(1)
Kentucky	301,036	(1)	147,540	(1)	(1)
New Mexico	597,072	(1)	(1)	----------	----------
Ohio	138,909	156,058	84,970	(1)	(1)
Oklahoma	(1)	----------	----------	----------	----------
Pennsylvania	22,136,664	9,574,341	10,722,352	5,716,207	3,442,006
Tennessee	302,637	127,609	122,410	104,808	103,791
Utah	(1)	146,009	121,475	84,865	28,097
Virginia	1,234,256	421,691	370,983	316,754	247,734
Washington	93,659	38,500	24,702	30,701	18,747
West Virginia	2,716,613	490,040	583,599	527,142	431,419
Combined States	461,393	152,459	110,682	232,756	76,809
	30,480,792	11,354,784	12,488,951	7,207,417	4,492,803
Grand total	56,478,372	51,266,943	56,865,537	51,092,143	52,805,828

[1] Included under "Combined States."

TABLE 17.—*By-product and beehive coke produced in Pennsylvania, 1927 and 1928, by districts*

[The figures of number of plants and ovens include those that were idle during the year]

District	Plants	Ovens		Coal used (net tons)	Yield of coke from coal (per cent)	Coke produced (net tons)	Value of coke at ovens	
		Built	Under construction				Total	Per ton
1927								
By-product:								
Eastern Pennsylvania[1]	5	829	-------	2,849,253	71.0	2,021,848	$10,738,680	$5.31
Western Pennsylvania[2]	7	2,600	-------	13,841,727	65.3	9,039,236	33,863,077	3.75
	12	3,429	-------	16,690,980	66.3	11,061,084	44,601,757	4.03
Beehive:								
Allegheny Mountain and Allegheny Valley	7	645	-------	120,065	60.0	72,038	350,754	4.87
Connellsville	62	15,055	-------	3,851,813	66.3	2,552,024	10,615,657	4.16
Lower Connellsville	48	11,158	-------	3,518,905	66.3	2,333,515	8,083,885	3.46
Upper Connellsville	11	1,427	-------	488,150	58.4	284,942	1,282,894	4.50
Pittsburgh and other districts[3]	14	3,850	-------	750,929	63.1	473,688	2,235,128	4.72
	142	32,135	-------	8,729,862	65.5	5,716,207	22,568,318	3.95
Grand total	154	35,564	-------	25,420,842	66.0	16,777,291	67,170,075	4.00
1928								
By-product:								
Eastern Pennsylvania[1]	5	749	74	2,695,181	71.5	1,926,399	9,524,386	4.94
Western Pennsylvania[2]	6	2,486	35	17,630,482	65.5	11,548,950	41,608,020	3.60
	11	3,235	109	20,325,663	66.3	13,475,349	51,132,406	3.79
Beehive:								
Allegheny Mountain and Allegheny Valley	6	619	-------	148,206	60.3	89,301	375,281	4.20
Connellsville	56	12,515	-------	1,408,687	66.0	930,217	3,284,814	3.53
Lower Connellsville	42	10,154	-------	2,637,833	66.6	1,757,436	5,129,489	2.92
Upper Connellsville	10	1,397	-------	408,252	60.9	248,525	996,135	4.01
Pittsburgh and other districts[3]	10	2,867	-------	663,379	62.8	416,527	1,729,647	4.15
	124	27,552	-------	5,266,357	65.4	3,442,006	11,515,366	3.35
Grand total	135	30,787	109	25,592,020	66.1	16,917,355	62,647,772	3.70

[1] Includes plants at Bethlehem, Chester, Lebanon, Steelton, and Swedeland.
[2] Includes in 1927 plants at Clairton, Dunbar, Erie, Johnstown, Midland, Pittsburgh, and Woodlawn; 1928, Clairton, Erie, Midland, Pittsburgh, and Woodlawn.
[3] Includes Bedford, Clearfield, Huntingdon, Jefferson, and parts of Indiana and Westmoreland Counties.

TABLE 18.—*By-product and beehive coke produced in Ohio, 1927 and 1928, by districts*

District	Plants	Ovens		Coal used (net tons)	Yield of coke from coal (per cent)	Coke produced (net tons)	Value of coke at ovens	
		Built	Under construction				Total	Per ton
1927								
By-product:								
Canton, Cleveland, and Massillon	5	580	-------	3, 697, 110	69. 9	2, 584, 773	$12, 651, 543	$4. 89
Youngstown	3	594	-------	3, 088, 197	64. 9	2, 005, 393	8, 987, 632	4. 48
Other districts[1]	7	604	-------	3, 685, 226	71. 2	2, 623, 453	13, 045, 290	4. 97
	15	1, 778	-------	10, 470, 533	68. 9	7, 213, 619	34, 684, 465	4. 81
Beehive	2	204	-------	(2)	(2)	(2)	(2)	(2)
Grand total	17	1, 982	-------	(2)	(2)	(2)	(2)	(2)
1928								
By-product:								
Canton, Cleveland, and Massillon	5	580	15	3, 807, 300	69. 1	2, 631, 938	11, 371, 547	4. 32
Youngstown	3	594	-------	3, 528, 393	64. 2	2, 264, 158	9, 225, 445	4. 07
Other districts[1]	8	646	-------	4, 130, 351	70. 0	2, 890, 103	13, 311, 871	4. 61
	16	1, 820	15	11, 466, 044	67. 9	7, 786, 199	33, 908, 863	4. 35
Beehive	1	202	-------	(2)	(2)	(2)	(2)	(2)
Grand total	17	2, 022	15	(2)	(2)	(2)	(2)	(2)

[1] Includes plants at Dover, Ironton, Lorain, Painesville, Portsmouth, Toledo, and Warren in 1927 with the addition of Hamilton in 1928.

[2] Not at liberty to publish.

TABLE 19.—*By-product and beehive coke produced in West Virginia, 1927 and 1928, by districts*

[The figures of number of plants and ovens include those that were idle during the year]

District	Plants	Ovens		Coal used (net tons)	Yield of coke from coal (per cent)	Coke produced (net tons)	Value of coke at ovens	
		Built	Under construction				Total	Per ton
1927								
By-product: Fairmont, Benwood, Follansbee, and Weirton	4	[1]411	-------	2, 065, 812	67. 6	1, 396, 285	$4, 679, 048	$3. 35
Beehive:								
Flat top	11	1, 621	-------	220, 084	56. 6	124, 524	543, 207	4. 36
Tug River	1	1, 885	-------	-----------	-----	-----------	-----------	-----
Kanawha, Upper Monongahela, and Panhandle	21	2, 107	-------	373, 690	60. 1	224, 606	758, 293	3. 38
New River	7	704	-------	240, 305	58. 4	140, 401	743, 429	5. 30
Upper Potomac and Tygarts Valley	7	582		63, 964	58. 8	37, 611	116, 381	3. 09
	47	6, 899	-------	898, 043	58. 7	527, 142	2, 161, 310	4. 10
Grand total	51	7, 310	-------	2, 963, 855	64. 9	1, 923, 427	6, 840, 358	3. 56
1928								
By-product: Fairmont, Benwood, Follansbee, and Weirton	4	[1]411	-------	1, 966, 364	69. 5	1, 367, 481	3, 761, 460	2. 75
Beehive:								
Flat Top	8	1, 351	-------	164, 228	57. 0	93, 556	378, 310	4. 04
Kanawha, Upper Monongahela, and Panhandle	18	1, 955	-------	357, 966	60. 9	217, 914	655, 955	3. 01
New River	7	700	-------	200, 485	56. 6	113, 495	489, 965	4. 32
Upper Potomac and Tygarts Valley	7	402	-------	10, 825	59. 6	6, 454	19, 703	3. 05
	40	4, 408	-------	733, 504	58. 8	431, 419	1, 543, 933	3. 58
Grand total	44	4, 819	-------	2, 699, 868	66. 6	1, 798, 900	5, 305, 393	2. 95

[1] Includes 291 Koppers and 120 Semet-Solvay ovens.

NUMBER AND TYPE OF OVENS

Tables 20 to 25 show the number and location of different types of coke ovens. Table 23 gives a complete list of the by-product plants, by name. A corresponding list of beehive coke plants would have little significance because of the many installations of beehive ovens still in existence that have produced no coke for years and probably never will produce again. The purchaser desiring to get in touch with producers of beehive coke is referred to a list on pages 611 to 613 of Coke and By-Products in 1926, which gives the name, location, and number of ovens at 182 beehive coke plants that were active in 1926.

TABLE 20.—*By-product coke ovens built and under construction at end of each year, by States, 1925–1928*

State	1925		1926		1927		1928	
	Built	Under construction	Built	Under construction	Built	Under construction	Built	Under construction
Alabama	1,276	--------	1,276	112	1,325	63	1,388	--------
Colorado	120	--------	120	--------	120	--------	120	--------
Connecticut	--------	--------	--------	--------	--------	61	61	--------
Illinois	849	--------	849	--------	849	101	937	21
Indiana	1,177	212	1,394	40	1,384	--------	1,384	--------
Kentucky	108	--------	108	--------	108	--------	108	--------
Maryland	300	--------	300	60	360	--------	360	--------
Massachusetts	419	--------	466	15	481	--------	381	--------
Michigan	420	2	420	120	561	--------	576	--------
Minnesota	220	--------	220	--------	215	41	196	--------
Missouri	64	--------	64	--------	64	--------	64	--------
New Jersey	206	--------	206	--------	207	--------	207	--------
New York	506	155	661	[1]117	778	--------	868	--------
Ohio	1,689	--------	1,689	89	1,778	--------	1,820	15
Pennsylvania	3,220	60	3,126	425	3,429	--------	3,235	109
Rhode Island	40	--------	40	--------	40	--------	40	--------
Tennessee	24	--------	24	--------	24	--------	24	--------
Utah	33	--------	33	--------	33	23	56	--------
Washington	20	--------	20	--------	20	--------	20	--------
West Virginia	311	--------	411	--------	411	--------	411	--------
Wisconsin	288	--------	288	--------	288	--------	288	--------
	11,290	429	11,716	[1]978	12,475	289	12,544	145

[1] Includes information published in Iron Age, Jan. 20, 1927, p. 257, as to ovens under construction at 1 plant.

TABLE 21.—*Beehive coke ovens at end of each year, by States, 1923–1928*

State	1923	1924	1925	1926	1927	1928	
						Built	Under construction
Alabama	6,199	6,199	4,961	1,831	1,831	953	----------
Colorado	1,758	1,696	1,681	1,527	1,498	1,498	----------
Georgia	151	151	151	151	151	----------	----------
Kentucky	795	795	795	763	763	608	----------
New Mexico	1,030	1,030	1,030	584	584	584	----------
Ohio	205	205	204	204	204	202	----------
Oklahoma	300	300	300	300	100	100	----------
Pennsylvania	37,578	36,030	34,668	34,375	32,135	27,552	----------
Tennessee	1,767	1,555	1,675	1,605	1,465	1,415	----------
Utah	819	819	819	819	819	819	----------
Virginia	3,284	3,234	3,124	2,914	3,014	2,914	----------
Washington	408	408	332	332	332	235	----------
West Virginia	8,055	8,010	7,847	7,153	6,899	4,408	----------
	62,349	60,432	57,587	52,558	49,795	41,288	----------

TABLE 22.—*Coke ovens completed and abandoned in 1928 and total number in existence and under construction at end of year, by States*

State	Plants in existence	Ovens						
		New [1]		Abandoned during year	In existence Dec. 31		Under construction Dec. 31	
		Number	Capacity per day (net tons of coke)		Number	Capacity per day (net tons of coke)	Number	Capacity per day (net tons of coke)
By-product:								
Alabama	8	63	1,305		1,388	16,467		
Colorado	1				120	1,700		
Connecticut	1	61	858		61	858		
Illinois	8	101	1,600	13	937	13,120	21	160
Indiana	7				1,384	19,287		
Kentucky	1				108	(2)		
Maryland	1				360	5,085		
Massachusetts	3			100	381	2,387		
Michigan	7				576	7,607		
Minnesota	3	46	790	65	196	3,472		
Missouri	1				64	(2)		
New Jersey	2				207	2,531		
New York	9	90	900		868	12,687		
Ohio	16	45	794	3	1,820	26,102	15	135
Pennsylvania	11			194	3,235	42,476	109	1,805
Rhode Island	1				40	(2)		
Tennessee	1				24	365		
Utah	1	23	415		56	1,015		
Washington	1				20	111		
West Virginia	4				411	4,623		
Wisconsin	2				288	(2)		
Undistributed						5,470		
	89	429	6,662	375	12,544	165,363	145	2,100
Beehive:								
Alabama	6			878	953	(3)		
Colorado	5				1,498			
Georgia				151				
Kentucky	2				608			
New Mexico	2				584			
Ohio	1			2	202			
Oklahoma	1				100			
Pennsylvania	124			4,622	27,552			
Tennessee	7			50	1,415			
Utah	1				819			
Virginia	12			100	2,914			
Washington	3			97	235			
West Virginia	40			2,399	4,408			
	204			8,299	41,288	(3)		

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[1] Represents new construction. Does not include ovens repaired and put into commission.
[2] Included under "Undistributed."
[3] Data not available.

TABLE 23.—*List of by-product coke plants in the United States, December 31, 1928*

State	Town	Name of company operating plant	Type of plant [1]	Number of ovens	Type of oven	Year put in operation [2]
Alabama	Alabama City	Gulf States Steel Co	F	37	Koppers	1916
	Ensley	Semet-Solvay Co	M	240	Semet-Solvay	1898-1902
	Fairfield	Tennessee Coal, Iron & R. R. Co.	F	497	Koppers	1912-1928
	North Birmingham.	Sloss-Sheffield Steel & Iron Co.	F	120	Semet-Solvay	1920
	Tarrant	Alabama By-Products Corp.	M	149	Koppers	1920-1927
	Thomas	Republic Iron & Steel Co	F	57	do	1925
	Tuscaloosa	Central Iron & Coal Co	F	60	Semet Solvay	1906-1914
	Woodward	Woodward Iron Co	F	168	Koppers	1911-1914
	do	do	F	60	Wilputte	1917
Colorado	Pueblo	Colorado Fuel & Iron Co	F	120	Koppers	1918
Connecticut	New Haven	Connecticut Coke Co	M	61	do	1928
Illinois	Chicago	People's Gas Light & Coke Co.	M	105	do	1921-22
	Granite City	St. Louis Gas & Coke Corp.	F	80	Roberts	1921
	Joliet	Illinois Steel Co	F	280	Koppers	1908-9
	Lockport	Coal Products Manufacturing Co.	M	17	Wilputte	1912
	do	do	M	36	Koppers	1912
	South Chicago	By-Products Coke Corp	M	120	Semet-Solvay	1905-1915
	do	do	M	110	Koppers	1925
	do	Wisconsin Steel Works	F	88	Wilputte	1919
	do	Youngstown Sheet & Tube Co.	F	70	Koppers	1928
	Waukegan	North Shore Coke & Chemical Co.	M	31	do	1928
Indiana	Fort Wayne	Northern Indiana Public Service Co.	M	19	do	1925
	Gary	Illinois Steel Co	F	838	do	1911-1926
	Indiana Harbor.	Inland Steel Co	F	204	do	1913-1926
	do	Youngstown Sheet & Tube Co.	F	120	Semet-Solvay	1919
	Indianapolis	Citizens Gas Co	M	41	do	1913
	do	do	M	80	Wilputte	1918-1927
	Muncie	Central Indiana Gas Co	M	22	Klönne	1912
	Terre Haute	Indiana Consumers Gas and By-Products Co.	M	60	Koppers	1919-1926
Kentucky	Ashland	Ashland By-Product Coke Co.	M	108	Semet-Solvay	1913-1916
Maryland	Sparrows Point	Bethlehem Steel Co	F	360	Koppers	1914-1927
Massachusetts	Everett	New England Fuel & Transportation Co.	M	300	United-Otto	1899
	do	do	M	55	Wilputte	1926
	Framingham	West Boston Gas Co	M	15	Koppers	1927
	Lynn	Lynn Gas & Elec. Co	M	11	do	1925
Michigan	Battle Creek	Battle Creek Gas Co	M	18	do	1924-1927
	Dearborn	Ford Motor Co	F	120	Semet-Solvay	1919
	do	do	F	120	Wilputte	1927
	Detroit	Semet-Solvay Co	M	216	Semet-Solvay	1901-1917
	Flint	Consumers Power Co	M	29	Koppers	1927
	Jackson	do	M	15	do	1925
	Wyandotte	Michigan Alkali Co	M	39	do	1927
	Zilwaukee	Consumers Power Co	M	19	do	1924
Minnesota	Duluth	Minnesota Steel Co	F	90	do	1915-16
	St. Paul	Minnesota By-Product Coke Co.	M	65	do	1918-1928
	West Duluth	Zenith Furnace Co	F	41	do	1928
Missouri	St. Louis	Laclede Gas Light Co	M	56	do	1915
	do	do	M	8	Piette	1921
New Jersey	Camden	Camden Coke Co	M	37	Koppers	1921
	Kearny	Seaboard By-Product Coke Co.	M	170	do	1917-1925
New York	Brooklyn	Brooklyn Union Gas Co	M	90	do	1928
	Buffalo	Donner-Hanna Coke Corp	F	150	do	1920
	do	Semet-Solvay Co	M	120	Semet-Solvay	1917-1927
	Geneva	Empire Gas & Electric Co	M	46	do	1904-1909
	Hunts Point	Consolidated Gas Co	M	74	Koppers	1926
	Lackawanna	Bethlehem Steel Co	F	60	Semet-Solvay	1920
	do	do	F	171	Koppers	1924-1927
	Rochester	Rochester Gas & Electric Co.	M	60	do	1926

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[1] F, "Furnace plants," or plants associated with iron furnaces and steelworks. M, "Nonfurnace plants," or "other plants" (see Tables 12-14), including merchant plants, plants associated with industries other than iron and steel, and plants supplying gas under contract for city use. Since the publication of the report for 1925 changes in classification of certain plants have been made to conform with changes in definition of what constitutes a furnace plant.

[2] The first and last years are given for those plants that have two or more installations.

TABLE 23.—*List of by-product coke plants in the United States, December 31,* 1928—Continued

State	Town	Name of company operating plant	Type of plant	Number of ovens	Type of oven	Year put in operation
New York	Troy	Hudson Valley Coke & Products Corp.	F	55	American	1925
	Utica	Utica Gas & Electric Co.	M	42	Koppers	1924-1926
Ohio	Campbell	Youngstown Sheet & Tube Co.	F	306	do	1916-1918
	Canton	Central Alloy Steel Corp.	F	47	do	1916
	Cleveland	American Steel & Wire Co.	F	180	do	1918
	do	Corrigan-McKinney Steel Co.	F	204	do	1916
	do	Otis Steel Co	F	100	Semet-Solvay	1910-1913
	Dover	Hanna Furnace Co	F	24	Roberts	1916
	Hamilton	Hamilton Coke & Iron Co.	F	45	Koppers	1928
	Ironton	Ironton By-Product Coke Co.	M	60	Semet-Solvay	1918
	Lorain	National Tube Co	F	208	Koppers	1918
	Massillon	Central Alloy Steel Corp.	F	49	do	1927
	Painesville	Diamond Alkali Co	M	43	do	1924-1927
	Portsmouth	Portsmouth By-Product Coke Co.	F	108	Semet-Solvay	1917
	Toledo	Toledo Furnace Co	F	94	Koppers	1916
	Warren	Trumbull-Cliffs Furnace Co.	F	64	do	1924-1927
	Youngstown	Republic Iron & Steel Co.	F	204	do	1914-1926
	do	Youngstown Sheet & Tube Co.	F	84	do	1917
Pennsylvania	Bethlehem	Bethlehem Steel Co	F	424	do	1918
	Chester	Philadelphia Suburban Gas & Electric Co.	M	25	Morrissey	1925
	Clairton	Carnegie Steel Co	F	1,482	Koppers	1918-1927
	Erie	Perry Iron Co	F	37	Wilputte	1925
	Johnstown	Bethlehem Steel Co	F	127	Koppers	1915-1927
	do	do	F	170	Cambria	1906-1920
	do	do	F	88	Semet-Solvay	1921
	Lebanon	do	F	90	do	1904-1921
	Midland	Pittsburgh Crucible Steel Co.	F	100	Koppers	1920
	Pittsburgh	Jones & Laughlin Steel Co.	F	300	do	1919-20
	do	do	F	60	Wilputte	1926
	Steelton	Bethlehem Steel Co	F	40	Semet-Solvay	1907
	do	do	F	60	Koppers	1919
	Swedeland	Rainey-Wood Coke Co	F	110	do	1919
	Woodlawn	Jones & Laughlin Steel Co.	F	122	do	1926
Rhode Island	Providence	Providence Gas Co	M	40	do	1919
Tennessee	Altonpark	Tennessee Products Corp.	M	24	Semet-Solvay	1915
Utah	Provo	Columbia Steel Corp	F	56	Koppers	1924-1928
Washington	Seattle	Seattle Lighting Co	M	20	Klönne	1914
West Virginia	Benwood	National Tube Co	M	120	Semet-Solvay	1898-1901
	Fairmont	Domestic Coke Corp	M	60	Koppers	1920
	Follansbee	Wheeling Steel Corp	F	145	do	1917-1926
	Weirton	Weirton Steel Co	F	86	do	1923-1926
Wisconsin	Mayville	Youngstown Sheet & Tube Co.	F	108	Otto-Hoffman	1914-1917
	Milwaukee	Milwaukee Coke & Gas Co.	M	80	Semet-Solvay	1901-1906
	do	do	M	100	Koppers	1921-22

TABLE 24.—*List of by-product ovens under construction in the United States, December 31, 1928*

State	Town	Name of company operating plant	Number of ovens	Type of oven	Date of operation
Illinois	Rockford	Rockford Gas Light & Coke Co.	21	Koppers	January, 1929.
Ohio	Canton	Central-Alloy Steel Corp	15	do	Do.
Pennsylvania	Neville Island	Davison Coke & Iron Co	35	do	October-November, 1929.
	Philadelphia	Philadelphia Coke Co	74	do	February, 1929.

TABLE 25.—*By-product ovens of each type at the end of the year, by States, in 1928*

State	Koppers[1]	Semet-Solvay	Wilputte	United Otto[2]	Cambria-Belgian	Roberts[3]	American	Klönne	Piette	Total
Alabama	908	420	60							1,388
Colorado	120									120
Connecticut	61									61
Illinois	632	120	105			80				937
Indiana	1,121	161	80					22		1,384
Kentucky		108								108
Maryland	360									360
Massachusetts	26		55	300						381
Michigan	120	336	120							576
Minnesota	196									196
Missouri	56								8	64
New Jersey	207									207
New York	587	226					55			868
Ohio	1,528	268				24				1,820
Pennsylvania	2,725	218	97		170	25				3,235
Rhode Island	40									40
Tennessee		24								24
Utah	56									56
Washington								20		20
West Virginia	291	120								411
Wisconsin	100	80		108						288
	9,134	2,081	517	408	170	129	55	42	8	12,544

[1] Includes the Koppers-Becker type.
[2] Includes the Otto-Hoffman and Schniewind types.
[3] Includes the Roberts-Morrissey type.

CAPACITY OF BY-PRODUCT OVENS

TABLE 26.—*Estimated annual potential production of coke and coal required for charge of by-product coke ovens in the United States, 1926–1928, when operated at different percentages of maximum capacity, in millions of net tons*

Percentage of maximum capacity	1926				1927				1928			
	Ovens completed Dec. 31		Including ovens under construction		Ovens completed Dec. 31		Including ovens under construction		Ovens completed Dec. 31		Including ovens under construction	
	Coke	Coal[1]	Coke	Coal[1]	Coke	Coal[1]	Coke	Coal[1]	Coke	Coal[1]	Coke	Coal[1]
100	52.7	75.3	58.7	83.9	57.9	82.7	59.5	85.0	60.5	86.4	61.3	87.6
90	47.4	67.8	52.8	75.5	52.1	74.4	53.6	76.5	54.5	77.8	55.2	78.8
85	44.8	64.0	49.9	71.3	49.2	70.3	50.6	72.3	51.4	73.4	52.1	74.5
75	39.5	56.5	44.0	62.9	43.4	62.0	44.6	63.8	45.4	64.8	46.0	65.7
50	26.4	37.7	29.4	42.0	29.0	41.4	29.8	42.5	30.3	43.2	30.7	43.8

[1] Coal for charge estimated on basis of 70 per cent yield in coke.

TABLE 27.—*Relation (per cent) of production to maximum capacity at by-product coke plants, 1923–1928, by months*

	1923	1924	1925	1926	1927	1928		1923	1924	1925	1926	1927	1928
January	83.2	81.4	86.0	94.6	84.5	80.4	August	86.5	61.1	77.8	88.3	79.8	82.8
February	85.0	83.8	86.0	96.4	85.4	82.2	September	85.9	65.7	80.9	88.7	80.8	84.3
March	87.2	84.8	85.7	93.8	87.2	83.2	October	82.8	71.7	82.0	88.5	76.4	86.3
April	88.7	81.4	84.9	89.5	84.8	82.6	November	81.1	74.8	88.5	88.9	74.2	86.8
May	89.1	73.1	80.9	89.0	83.9	83.5	December	80.1	80.8	90.6	84.7	74.6	87.8
June	87.6	65.3	80.3	88.4	82.3	83.2							
July	87.2	59.2	78.0	89.3	79.3	81.0	The year	85.4	73.4	83.5	89.9	80.9	83.7

QUANTITY AND COST OF COAL CHARGED

Although the quantity of coal used in the manufacture of coke has been increasing at a rapid rate during the past 30 years (Coke and By-Products in 1925, p. 558), the proportion carbonized of the total output of bituminous coal each year has remained remarkably constant, ranging from 12 to about 15 per cent. The only recent year that showed marked digression from this general trend was 1921, when the country was in the grip of a profound business depression that dealt especially severely with the heavy industries, the principal consumers of coke. In 1928 the coke ovens in the United States used 77,183,880 tons, 15.4 per cent of the total output of bituminous coal. (See Table 28.) Of this amount 70,165,906 tons was used in the by-product ovens.

Increasing interest in the marketing of coal has led to a demand for current figures of the quantity of coal required by the major industries from month to month. Statistics of the quantity charged in by-product coke ovens therefore have been published monthly since March, 1929, by the bureau in the Current Trend of Consumption Analysis, issued as an appendix to the Weekly Coal Report. To furnish a background to this current analysis Table 29 has been prepared.

TABLE 28.—*Coal used in manufacture of coke in the United States, 1918–1928, in net tons*

[For comparable figures back to 1880 see Coke and By-products in 1925, p. 558]

Year	By-product	Beehive	Total	Year	By-product	Beehive	Total
1918	36,867,721	48,160,297	85,028,018	1924	49,061,339	15,914,310	64,975,649
1919	35,857,419	29,730,499	65,587,918	1925	57,109,651	17,422,581	74,532,232
1920	44,204,996	31,985,836	76,190,832	1926	63,646,610	19,224,500	82,871,110
1921	28,713,111	8,475,446	37,188,557	1927	63,239,773	11,208,115	74,447,888
1922	41,052,670	13,285,868	54,338,538	1928	70,165,906	7,017,974	77,183,880
1923	54,275,577	30,084,366	84,359,943				

TABLE 29.—*Coal consumed in coke ovens, 1912–1928, by months, in net tons*

Month	1912			1913			1914		
	By-product	Beehive	Total	By-product	Beehive	Total	By-product	Beehive	Total
Jan	1,034,000	3,947,000	4,981,000	1,453,000	4,850,000	6,303,000	1,241,000	3,258,000	4,499,000
Feb	1,034,000	4,002,000	5,036,000	1,385,000	4,471,000	5,856,000	1,178,000	3,308,000	4,486,000
Mar	1,166,000	4,451,000	5,617,000	1,522,000	4,518,000	6,040,000	1,426,000	4,107,000	5,533,000
Apr	1,123,000	4,284,000	5,407,000	1,385,000	4,496,000	5,881,000	1,364,000	3,627,000	4,991,000
May	1,196,000	4,458,000	5,654,000	1,418,000	4,659,000	6,077,000	1,348,000	3,085,000	4,433,000
June	1,226,000	4,107,000	5,333,000	1,436,000	4,358,000	5,794,000	1,271,000	2,926,000	4,197,000
July	1,285,000	3,923,000	5,208,000	1,471,000	4,399,000	5,870,000	1,318,000	3,060,000	4,378,000
Aug	1,329,000	4,295,000	5,624,000	1,538,000	4,363,000	5,901,000	1,395,000	2,923,000	4,318,000
Sept	1,299,000	3,978,000	5,277,000	1,504,000	4,270,000	5,774,000	1,348,000	2,776,000	4,124,000
Oct	1,359,000	4,546,000	5,905,000	1,470,000	4,456,000	5,926,000	1,301,000	2,577,000	3,878,000
Nov	1,403,000	4,475,000	5.878,000	1,334,000	3,882,000	5,216,000	1,147,000	2,110,000	3,257,000
Dec	1,314,000	4,344,000	5,658,000	1,179,000	3,422,000	4,601,000	1,163,000	2,367,000	3,530,000
	14,768,000	50,810,000	65,578,000	17,095,000	52,144,000	69,239,000	15,500,000	36,124,000	51,624,000

TABLE 29.—*Coal consumed in coke ovens, 1912–1928, by months, in net tons*—Continued

Month	1915			1916			1917		
	By-product	Beehive	Total	By-product	Beehive	Total	By-product	Beehive	Total
Jan	1, 192, 000	2, 222, 000	3, 414, 000	2, 095, 000	4, 534, 000	6, 629, 000	2, 511, 000	4, 604, 000	7, 115, 000
Feb	1, 173, 000	2, 433, 000	3, 606, 000	2, 015, 000	4, 484, 000	6, 499, 000	2, 537, 000	3, 922, 000	6, 459, 000
Mar	1, 349, 000	2, 866, 000	4, 215, 000	2, 175, 000	5, 068, 000	7, 243, 000	2, 546, 000	4, 945, 000	7, 491, 000
Apr	1, 427, 000	2, 830, 000	4, 257, 000	2, 095, 000	4, 466, 000	6, 561, 000	2, 610, 000	4, 433, 000	7, 043, 000
May	1, 506, 000	2, 976, 000	4, 482, 000	2, 202, 000	4, 728, 000	6, 930, 000	2, 638, 000	4, 507, 000	7, 145, 000
June	1, 526, 000	3, 397, 000	4, 923, 000	2, 123, 000	4, 533, 000	6, 656, 000	2, 640, 000	4, 339, 000	6, 979, 000
July	1, 662, 000	3, 604, 000	5, 266, 000	2, 202, 000	4, 226, 000	6, 428, 000	2, 642, 000	4, 338, 000	6, 980, 000
Aug	1, 780, 000	3, 924, 000	5, 704, 000	2, 255, 000	4, 658, 000	6, 913, 000	2, 689, 000	4, 174, 000	6, 863, 000
Sept	1, 858, 000	3, 968, 000	5, 826, 000	2, 255, 000	4, 685, 000	6, 940, 000	2, 694, 000	4, 296, 000	6, 990, 000
Oct	1, 974, 000	4, 656, 000	6, 630, 000	2, 387, 000	4, 783, 000	7, 170, 000	2, 665, 000	4, 379, 000	7, 044, 000
Nov	2, 015, 000	4, 649, 000	6, 664, 000	2, 307, 000	4, 557, 000	6, 864, 000	2, 668, 000	4, 217, 000	6, 885, 000
Dec	2, 092, 000	4, 754, 000	6, 846, 000	2, 413, 000	4, 363, 000	6, 776, 000	2, 666, 000	4, 092, 000	6, 758, 000
	19, 554, 000	42, 279, 000	61, 833, 000	26, 524, 000	55, 085, 000	81, 609, 000	31, 506, 000	52, 246, 000	83, 752, 000

Month	1918			1919			1920		
	By-product	Beehive	Total	By-product	Beehive	Total	By-product	Beehive	Total
Jan	2, 323, 000	3, 564, 000	5, 887, 000	3, 488, 000	3, 694, 000	7, 182, 000	3, 478, 000	3, 035, 000	6, 513, 000
Feb	2, 175, 000	3, 516, 000	5, 691, 000	3, 071, 000	2, 759, 000	5, 830, 000	3, 359, 000	2, 659, 000	6, 018, 000
Mar	2, 876, 000	4, 190, 000	7, 066, 000	3, 259, 000	2, 676, 000	5, 935, 000	3, 793, 000	3, 082, 000	6, 875. 000
Apr	2, 839, 000	4, 094, 000	6, 933, 000	2, 889, 000	1, 994, 000	4, 883, 000	3, 250, 000	2, 462, 000	5, 712, 000
May	2, 986, 000	4, 334, 000	7, 320, 000	2, 719, 000	1, 719, 000	4, 438, 000	3, 441, 000	2, 606, 000	6, 047, 000
June	2, 950, 000	4, 287, 000	7, 237, 000	2, 760, 000	1, 785, 000	4, 545, 000	3, 565, 000	2, 625, 000	6, 190, 000
July	3, 245, 000	4, 479, 000	7, 724, 000	3, 201, 000	2, 275, 000	5, 476, 000	3, 811, 000	2, 598, 000	6, 409, 000
Aug	3, 355, 000	4, 187, 000	7, 542, 000	3, 232, 000	2, 624, 000	5, 856, 000	3, 931, 000	2, 727, 000	6, 658, 000
Sept	3, 392, 000	4, 094, 000	7, 486, 000	3, 093, 000	2, 710, 000	5, 803, 000	3, 934, 000	2, 699, 000	6, 633, 000
Oct	3, 612, 000	4, 141, 000	7, 753, 000	2, 493, 000	2, 348, 000	4, 841, 000	4, 179, 000	2, 676, 000	6, 855, 000
Nov	3, 540, 000	3, 710, 000	7, 250, 000	2, 811, 000	2, 543, 000	5, 354, 000	3, 841, 000	2, 503, 000	6, 344, 000
Dec	3, 575, 000	3, 564, 000	7, 139, 000	2, 841, 000	2, 604, 000	5, 445, 000	3, 623, 000	2, 314, 000	5, 937, 000
	36, 868, 000	48, 160, 000	85, 028, 000	35, 857, 000	29, 731, 000	65, 588, 000	44, 205, 000	31, 986, 000	76, 191, 000

Month	1921			1922			1923		
	By-product	Beehive	Total	By-product	Beehive	Total	By-product	Beehive	Total
Jan	3, 284, 000	1, 665, 000	4, 949, 000	2, 712, 000	820, 000	3, 532, 000	4, 478, 000	2, 474, 000	6, 952, 000
Feb	2, 721, 000	1, 331, 000	4, 052, 000	2, 588, 000	908, 000	3, 496, 000	4, 132, 000	2, 481, 000	6, 613, 000
Mar	2, 554, 000	885, 000	3, 439, 000	3, 073, 000	1, 210, 000	4, 283, 000	4, 703, 000	2, 928, 000	7, 631, 000
Apr	2, 189, 000	505, 000	2, 694, 000	3, 172, 000	874, 000	4, 046, 000	4, 631, 000	2, 971, 000	7, 602, 000
May	2, 293, 000	462, 000	2, 755, 000	3, 658, 000	721, 000	4, 379, 000	4, 807, 000	3, 061, 000	7, 868, 000
June	2, 030, 000	357, 000	2, 387, 000	3, 730, 000	761, 000	4, 491, 000	4, 573, 000	2, 937, 000	7, 510, 000
July	1, 870, 000	277, 000	2, 147, 000	3, 596, 000	738, 000	4, 334, 000	4, 718, 000	2, 648, 000	7, 366, 000
Aug	1, 993, 000	383, 000	2, 376, 000	2, 620, 000	879, 000	3, 499, 000	4, 679, 000	2, 501, 000	7, 180, 000
Sept	2, 051, 000	445, 000	2, 496, 000	3, 234, 000	1, 006, 000	4, 240, 000	4, 497, 000	2, 297, 000	6, 794, 000
Oct	2, 501, 000	640, 000	3, 141, 000	4, 043, 000	1, 449, 000	5, 492, 000	4, 478, 000	2, 159, 000	6, 637, 000
Nov	2, 546, 000	735, 000	3, 281, 000	4, 214, 000	1, 881, 000	6, 095, 000	4, 248, 000	1, 846, 000	6, 094, 000
Dec	2, 681, 000	791, 000	3, 472, 000	4, 413, 000	2, 039, 000	6, 452, 000	4, 332, 000	1, 781, 000	6, 113, 000
	28, 713, 000	8, 476, 000	37, 189, 000	41, 053, 000	13, 286, 000	54, 339, 000	54, 276, 000	30, 084, 000	84, 360, 000

Month	1924			1925			1926		
	By product	Beehive	Total	By-product	Beehive	Total	By-product	Beehive	Total
Jan	4, 465, 000	1, 900, 000	6, 365, 000	4, 871, 000	1, 904, 000	6, 775, 000	5, 444, 000	2, 309, 000	7, 753, 000
Feb	4, 302, 000	1, 993, 000	6, 295, 000	4, 462, 000	1, 714, 000	6, 176, 000	5, 008, 000	2, 346, 000	7, 354, 000
Mar	4, 649, 000	2, 211, 000	6, 860, 000	4, 935, 000	1, 636, 000	6, 571, 000	5, 410, 000	1, 938, 000	7, 348, 000
Apr	4, 344, 000	1, 776, 000	6, 120, 000	4, 733, 000	1, 310, 000	6, 043, 000	5, 169, 000	1, 644, 000	6, 813, 000
May	4, 053, 000	1, 253, 000	5, 306, 000	4, 693, 000	1, 089, 000	5, 782, 000	5, 343, 000	1, 484, 000	6, 827, 000
June	3, 501, 000	913, 000	4, 414, 000	4, 509, 000	970, 000	5, 479, 000	5, 183, 000	1, 358, 000	6, 541, 000
July	3, 420, 000	736, 000	4, 156, 000	4, 532, 000	861, 000	5, 393, 000	5, 408, 000	1, 318, 000	6, 726, 000
Aug	3, 530, 000	715, 000	4, 245, 000	4, 520, 000	983, 000	5, 503, 000	5, 367, 000	1, 259, 000	6, 626, 000
Sept	3, 674, 000	860, 000	4, 534, 000	4, 547, 000	1, 218, 000	5, 765, 000	5, 221, 000	1, 373, 000	6, 594, 000
Oct	4, 185, 000	1, 038, 000	5, 223, 000	4, 858, 000	1, 639, 000	6, 497, 000	5, 449, 000	1, 451, 000	6, 900, 000
Nov	4, 224, 000	1, 037, 000	5, 261, 000	5, 080, 000	1, 973, 000	7, 053, 000	5, 350, 000	1, 439, 000	6, 789, 000
Dec	4, 715, 000	1, 482, 000	6, 197, 000	5, 370, 000	2, 125, 000	7, 495, 000	5, 295, 000	1, 305, 000	6, 600, 000
	49, 062, 000	15, 914, 000	64, 976, 000	57, 110, 000	17, 422, 000	74, 532, 000	63, 647, 000	19, 224, 000	82, 871, 000

TABLE 29.—*Coal consumed in coke ovens, 1912–1928, by months, in net tons*—Continued

Month	1927			1928		
	By-product	Beehive	Total	By-product	Beehive	Total
January	5, 341, 000	1, 260, 000	6, 601, 000	5, 673, 000	601, 000	6, 274, 000
February	4, 941, 000	1, 207, 000	6, 148, 000	5, 419, 000	625, 000	6, 044, 000
March	5, 586, 000	1, 424, 000	7, 010, 000	5, 917, 000	717, 000	6, 634. 000
April	5, 339, 000	1, 247, 000	6, 586, 000	5, 713, 000	605, 000	6, 318. 000
May	5, 454, 000	1, 008, 000	6, 462, 000	5, 968, 000	603, 000	6, 571, 000
June	5, 179, 000	927, 000	6, 106, 000	5, 766, 000	486. 000	6, 252, 000
July	5, 267, 000	746, 000	6, 013, 000	5, 693, 000	437, 000	6, 130, 000
August	5, 299, 000	778, 000	6, 077, 000	5, 815, 000	464, 000	6, 279, 000
September	5, 189, 000	731, 000	5, 920, 000	5, 761, 000	503, 000	6, 264, 000
October	5, 356, 000	670, 000	6, 026, 000	6, 142, 000	673, 000	6, 815, 000
November	5, 039, 000	607, 000	5, 646, 000	6, 015, 000	667, 000	6, 682, 000
December	5, 250, 000	603, 000	5, 853, 000	6, 284, 000	637, 000	6, 921, 000
	63, 240, 000	11, 208, 000	74, 448, 000	70, 166, 000	7, 018, 000	77, 184, 000

Table 30 shows the quantity of coal charged into ovens in each State and the value at the ovens. The cost of coal constitutes the chief item of expense in the manufacture of coke. In 1928 the cost per ton of raw coal f. o. b. ovens ranged from $1.50 in West Virginia, where beehive coke is made at the mines, to $5.31 in Minnesota, where the cost includes heavy freight charges from distant mines.

The average cost of coal used in beehive ovens in 1928 amounted to $1.88 a ton, and the cost of the coal equivalent of 1 ton of merchantable coke was $2.93.

At the by-product ovens in 1928 the average cost per ton of the coal charged was $3.57, a considerable decrease from the cost in the preceding year and the lowest in any year since the World War.

TABLE 30.—*Total quantity and value at ovens of coal used in the manufacture of coke, by States, 1927 and 1928*

State	Coal used (net tons)	Cost of coal		Coal per ton of coke	
		Total	Per ton of coal	Net tons	Cost
1927					
By-product plants:					
Alabama	6, 203, 290	$16, 363, 237	$2. 64	1. 42	$3. 75
Colorado	867, 792	(1)	(1)	1. 46	------
Illinois	4, 367, 337	20, 404, 573	4. 67	1. 45	6. 77
Indiana	7, 448, 393	37, 612, 644	5. 05	1. 34	6. 77
Maryland	1, 476, 742	(1)	(1)	1. 37	------
Massachusetts	1, 092, 900	5, 377, 136	4. 92	1. 47	7. 23
Michigan	2, 693, 576	12, 666, 987	4. 70	1. 40	6. 58
Minnesota	919, 801	5, 044, 602	5. 48	1. 45	7. 95
New Jersey	1, 244, 627	(1)	(1)	1. 37	------
New York	5, 114, 280	24, 103, 032	4. 71	1. 42	6. 69
Ohio	10, 470, 533	40, 589, 989	3. 88	1. 45	5. 63
Pennsylvania	16, 690, 980	49, 299, 291	2. 95	1. 51	4. 45
Tennessee	162, 372	537, 490	3. 31	1. 33	4. 40
Utah	318, 367	(1)	(1)	1. 61	------
Washington	64, 926	338, 429	5. 21	1. 60	8. 34
West Virginia	2, 065, 812	5, 860, 630	2. 84	1. 48	4. 20
Kentucky, Missouri, Rhode Island, and Wisconsin	2, 038, 045	8, 660, 231	4. 25	1. 41	5. 99
Undistributed	------	17, 815, 855	4. 56	------	------
	63, 239, 773	244, 674, 126	3. 87	1. 44	5. 57

TABLE 30.—*Total quantity and value at ovens of coal used in the manufacture of coke, by States, 1927 and 1928*—Continued

State	Coal used (net tons)	Cost of coal		Coal per ton of coke	
		Total	Per ton of coal	Net tons	Cost
1927—Continued					
Beehive plants:					
Colorado	299,559	(1)	(1)	1.54	------
Pennsylvania	8,729,862	$17,544,410	$2.01	1.53	$3.08
Tennessee	185,829	428,748	2.31	1.77	4.09
Utah	142,053	(1)	(1)	1.67	------
Virginia	528,032	1,048,519	1.99	1.67	3.32
Washington	47,953	213,391	4.45	1.56	6.94
West Virginia	898,043	1,405,206	1.56	1.70	2.65
Georgia, Kentucky, and Ohio	376,784	1,178,834	3.13	1.62	5.07
Undistributed	------------	1,442,519	3.27	--------	------
	11,208,115	23,261,627	2.08	1.56	3.24
1928					
By-product plants:					
Alabama	6,215,804	16,316,220	2.62	1.44	3.77
Colorado	891,315	(1)	(1)	1.47	------
Illinois	4,712,289	20,278,587	4.30	1.45	6.24
Indiana	8,202,943	38,983,679	4.75	1.35	6.41
Maryland	1,635,668	(1)	(1)	1.38	------
Massachusetts	1,035,336	5,030,773	4.86	1.51	7.34
Michigan	3,397,164	14,829,539	4.37	1.42	6.21
Minnesota	899,938	4,782,844	5.31	1.45	7.70
New Jersey	1,252,990	(1)	(1)	1.39	------
New York	5,501,162	23,803,437	4.33	1.45	6.28
Ohio	11,466,044	39,376,695	3.43	1.47	5.04
Pennsylvania	20,325,663	56,354,542	2.77	1.51	4.18
Tennessee	151,424	471,686	3.12	1.34	4.18
Utah	448,350	(1)	(1)	1.82	------
Washington	64,458	340,163	5.28	1.58	8.34
West Virginia	1,966,364	5,059,164	2.57	1.44	3.70
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	1,998,994	7,745,241	3.87	1.41	5.46
Undistributed	------------	17,233,718	4.08	--------	------
	70,165,906	250,606,288	3.57	1.45	5.18
Beehive plants:					
Colorado	220,515	(1)	(1)	1.53	------
Pennsylvania	5,266,357	9,701,498	1.84	1.53	2.82
Tennessee	173,706	371,747	2.14	1.67	3.57
Utah	48,675	(1)	(1)	1.73	------
Virginia	420,765	681,827	1.62	1.70	2.75
Washington	29,353	130,034	4.30	1.57	6.75
West Virginia	733,504	1,098,076	1.50	1.70	2.55
Georgia, Kentucky, and Ohio	125,099	315,162	2.52	1.63	4.11
Undistributed	------------	862,797	3.21	--------	------
	7,017,974	13,161,141	1.88	1.56	2.93

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[1] Included under "Undistributed."

TABLE 31.—*Average cost per net ton of coal charged into by-product coke ovens, by States, 1919–1928*

State	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928
Alabama	$3.35	$4.10	$3.29	$2.47	$2.95	$2.85	$2.68	$2.65	$2.64	$2.62
Illinois	4.73	6.49	5.90	5.92	5.78	5.16	4.89	4.75	4.67	4.30
Indiana	4.63	5.92	5.89	5.70	5.77	5.23	5.03	5.00	5.05	4.75
Kentucky	3.40	4.84	4.20	4.28	(1)	(1)	(1)	(1)	(1)	(1)
Massachusetts	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	4.92	4.86
Michigan	4.60	7.03	5.77	5.65	5.79	5.34	4.76	4.75	4.70	4.37
Minnesota	4.33	6.50	7.12	6.79	6.74	5.89	5.33	5.33	5.48	5.31
New York	4.34	6.20	5.86	5.60	5.31	4.75	4.51	4.60	4.71	4.33
Ohio	3.85	5.75	4.94	5.04	4.84	4.04	3.82	3.86	3.88	3.43
Pennsylvania	2.99	3.91	3.39	3.78	3.77	3.19	2.97	2.97	2.95	2.77
Tennessee	3.64	4.30	3.84	3.84	3.50	3.33	3.00	3.02	3.31	3.12
Washington	5.89	6.63	6.53	5.50	5.44	5.39	5.32	5.32	5.21	5.28
West Virginia	3.18	4.82	3.89	4.07	4.03	3.82	3.06	3.07	2.84	2.57
Average	3.96	5.40	4.84	4.73	4.76	4.13	3.86	3.88	3.87	3.57
Cost of coal per ton of coke	5.65	7.73	7.03	6.81	6.85	5.95	5.52	5.55	5.57	5.18

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[1] Not at liberty to publish.

Table 32 and Figure 42 trace the relative values of the coke and the by-products and the cost of coking coal, all reckoned per ton of coke produced. Thus in 1913 the average value of by-product coke was $3.83, the value of the by-products per ton of coke was $1.41, and the cost of coal per ton of coke was $3.27. In 1928 the value of the coke had risen to $4.90 per ton and the value of the by-products per ton of coke to $3.66, and the cost of coal per ton of coke was $5.18. These figures, of course, represent merely the gross value of the products and a single item of cost; they take no account of the other costs of manufacture, such as wages, salaries, purchased electric power, insurance, taxes, and fixed charges on a very large investment. No data on total cost and therefore on profits have been collected, but the diagram indicates clearly the trends of the market. Particularly important to the coke producers were the shifts in the values of the several by-products. (See fig. 59.) Increases in the values of tar and gas have more than offset a decline in the value of the benzols and ammonia, and the gross value of all the by-products reckoned per ton of coke is now much higher than before the war.

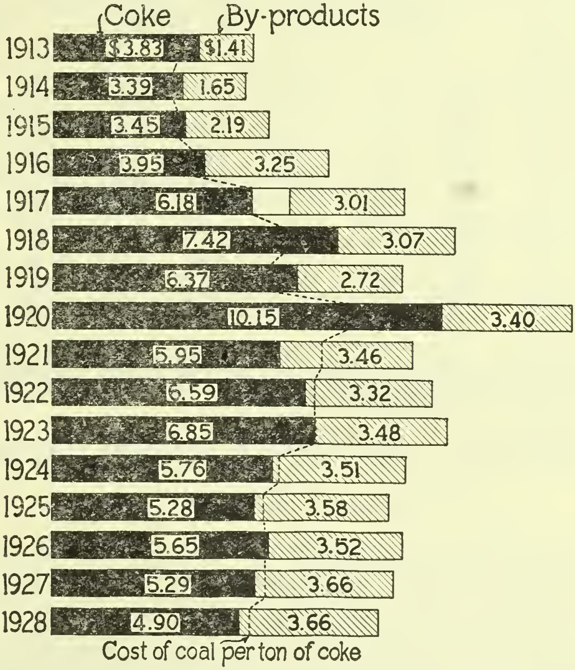

FIGURE 42.—Average value of by-product coke and gross value of by-products and cost of coal per ton of coke produced. It should be noted that these figures represent the gross values of the products and that there are many other expenses besides the cost of coking coal, including other materials, wages, salaries, purchased electric power, rents, insurance, taxes, and fixed charges on a large investment. No data on total costs or profits have been collected

TABLE 32.—*Cost of coal and value of all products per net ton of coke produced, 1913–1928*

[All figures reduced to value per net ton of coke produced]

Year	By-product coke					Beehive coke		
	Value of coke per ton[1]	Per ton of coke				Value of coke per ton[1]	Per ton of coke	
		Value of all by-products	Total value of products	Cost of coal	Excess, products over coal		Cost of coal	Excess, coke over coal
913	$3.83	$1.41	$5.24	$3.27	$1.97	$2.39	$1.75	$0.64
914	3.39	1.65	5.04	3.19	1.85	2.15	1.67	.48
915	3.45	2.19	5.64	3.24	2.40	2.07	1.61	.46
1916	3.95	3.25	7.20	3.62	3.58	2.69	1.96	.73
1917	6.18	3.01	9.19	5.20	3.99	4.81	3.17	1.64
1918	7.42	3.07	10.49	6.00	4.49	6.21	3.65	2.56
1919	6.37	2.72	9.09	5.65	3.44	5.15	3.39	1.76
1920	10.15	3.40	13.55	7.73	5.82	7.94	4.90	3.04
1921	5.95	3.46	9.41	7.03	2.38	5.45	3.82	1.63
1922	6.59	3.32	9.91	6.81	3.10	5.84	4.05	1.79
1923	6.85	3.48	10.33	6.85	3.48	5.98	3.97	2.01
1924	5.76	3.51	9.27	5.95	3.32	4.70	3.44	1.26
1925	5.28	3.58	8.86	5.52	3.34	4.56	3.14	1.42
1926	5.65	3.52	9.17	5.55	3.62	4.57	3.08	1.49
1927	5.29	3.66	8.95	5.57	3.38	4.20	3.24	.96
1928	4.90	3.66	8.56	5.18	3.38	3.63	2.93	.70

[1] Includes operators' statements of the value of coke consumed by them in associated enterprises but not sold, except that in 1918 and 1920 the value of such coke was estimated for each State at the average value for that State of the part of the product reported sold.

PREPARATION AND SOURCE OF COAL CHARGED

WASHED AND UNWASHED COAL

In Alabama, Colorado, Tennessee, Washington, and certain parts of Pennsylvania and West Virginia the coal used is washed before it is charged in the ovens. For the country as a whole in 1928, 15.1 per cent of the coal used in by-product ovens and 17 per cent of that in beehive ovens was washed. (See Table 33.) The washing is done sometimes by the coal producer at the mine and sometimes by the coke producer at the plant.

TABLE 33.—*Washed and unwashed coal used in the manufacture of by-product and beehive coke, by States in which used, in 1928, in net tons*

State	Washed	Unwashed	Total
By-product ovens:			
Alabama	[1]6, 215, 804	(1)	6, 215, 804
Colorado	891, 315		891, 315
Illinois		4, 712, 289	4, 712, 289
Indiana		8, 202, 943	8, 202, 943
Maryland		1, 635, 668	1, 635, 668
Massachusetts		1, 035, 336	1, 035, 336
Michigan	219, 804	3, 177, 360	3, 397, 164
Minnesota		899, 938	899, 938
New Jersey		1, 252, 990	1, 252, 990
New York	692, 047	4, 809, 115	5, 501, 162
Ohio		11, 466, 044	11, 466, 044
Pennsylvania	2, 463, 932	17, 861, 731	20, 325, 663
Tennessee	151, 424		151, 424
Utah		448, 350	448, 350
Washington	64, 458		64, 458
West Virginia		1, 966, 364	1, 966, 364
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin		1, 998, 994	1, 998, 994
	[1]10, 580, 065	[1]59, 585, 841	70, 165, 906
Beehive ovens:			
Colorado	[1]220, 515	(1)	220, 515
Pennsylvania	659, 616	4, 606, 741	5, 266, 357
Tennessee	139, 185	34, 521	173, 706
Utah		48, 675	48, 675
Virginia		420, 765	420, 765
Washington	29, 353		29, 353
West Virginia	159, 472	574, 032	733, 504
Georgia, Kentucky, and Ohio		125, 099	125, 099
	[1]1, 190, 621	[1]5, 827, 353	7, 017, 974

[1] A small amount of unwashed coal, which can not be shown separately, is included with the washed.

SOURCE OF BY-PRODUCT COAL IN 1928

Because of the wide interest in supplies of coal suitable for the manufacture of by-product coke the bureau asks each operator for a statement of the source of the coal charged during the year. In Table 34 the quantities reported are grouped by field of origin in as great detail as the nature of the replies permits. Considerable tonnages were so reported that they could not be accurately separated by fields, and it is hoped that in future the analysis can be made more detailed and exact.

The Appalachian fields remain the great source of by-product coal, but it is interesting to note that 561,600 tons was drawn from southern Illinois, 17,337 tons from western Kentucky, 1,015,826 tons from the Trinidad field of Colorado, 435,385 from Carbon County, Utah, and 64,458 from Pierce County, Wash.

Table 35 analyzes the distribution of by-product coking coal from State where produced to State where used.

The sources of by-product coking coal in 1928 are shown graphically in Figure 43, and in Figures 44 and 45 are indicated the location and capacity of the consuming plants. Taken together, the three maps bring out clearly the problem of transportation in moving the raw coal from mine to place of use.

TABLE 34.—*Coal used in the manufacture of by-product coke in 1928, by field of origin, in net tons*

[Based upon detailed reports from each coke plant. The difference between these totals and those shown in Tables 3, 30, etc., is due to change in stock, loss of weight in handling, and to the fact that these sometimes represent purchases during the year rather than actual consumption]

State and district where coal was produced	Total used	States where coal was consumed—in order of importance
Alabama	6,469,460	Alabama.
Colorado:		
Trinidad	1,015,826	Colorado.
Pitkin	14,269	Utah.
Georgia: Durham	8,959	Tennessee.
Illinois: Southern	561,600	Illinois.
Kentucky:		
Western Kentucky	17,337	Do.
Eastern Kentucky—		
Elkhorn	2,376,408	Michigan, Ohio, Kentucky, Indiana, Illinois, New York, Minnesota, and Missouri.
Harlan	5,187,360	Indiana, Michigan, Illinois, and Ohio.
Pond Creek and Alma	730,276	Ohio and Indiana.
Thacker	15,690	Illinois.
Unspecified	872,185	Illinois, Minnesota, New York, Indiana, and Massachusetts.
Pennsylvania:		
Connellsville	19,017,167	Pennsylvania, Ohio, New York, West Virginia, Minnesota, Illinois, and Indiana.
Pittsburgh	6,622,159	Pennsylvania, New York, Ohio, West Virginia, Minnesota, and New Jersey.
Westmoreland	160,185	New York, Massachusetts, and Rhode Island.
Freeport	1,307,598	West Virginia, Indiana, Michigan, and Pennsylvania.
Central Pennsylvania, high and medium volatile.	2,198,168	Pennsylvania, Maryland, and New York.
Central Pennsylvania, low volatile.	2,166,963	Pennsylvania and New York.
Somerset	355,079	Pennsylvania and Ohio.
Unspecified	399,214	New York.
Tennessee	129,148	Tennessee.
Utah: Carbon County	435,385	Utah.
Virginia: Wise, Lee, and Dickenson Counties.[1]	1,368,959	New Jersey, New York, Massachusetts, Missouri, and Illinois.
Washington: Pierce County	64,458	Washington.
West Virginia:		
Northern	3,590,655	Maryland, Pennsylvania, Ohio, Massachusetts, West Virginia, and New Jersey.
Kanawha and Logan	4,216,148	Indiana, Illinois, Michigan, Wisconsin, Ohio, Rhode Island, New York, Kentucky, and New Jersey.
Pocahontas[1]	9,492,954	Indiana, Ohio, Michigan, Illinois, New York, Massachusetts, Minnesota, Pennsylvania, West Virginia, Wisconsin, Alabama, Connecticut, and New Jersey.
New River and Winding Gulf	1,690,007	New Jersey, Illinois, New York, Kentucky, Minnesota, Missouri, Indiana, Connecticut, Wisconsin, and Rhode Island.
Thacker	9,510	Wisconsin.
Southeastern[2]	664,819	New York, Illinois, West Virginia, and Minnesota.
State not reported	5,685	Missouri.
	71,163,631	

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[1] Coal from the extension of the Pocahontas field in Tazewell County, Va., is included under West Virginia (Pocahontas).

[2] Includes Pocahontas, New River, Winding Gulf, and Southern.

TABLE 35.—*Coal used in the manufacture of by-product coke in 1928, by State where produced and State where consumed, in net tons*

State where coal was used	Coal produced in—					
	Alabama	Colorado	Georgia	Illinois	Kentucky	Pennsylvania
Alabama	6,469,460					
Colorado		1,015,826				
Illinois				561,600	1,740,916	(1)
Indiana					2,267,064	731,881
Maryland						549,748
Massachusetts					[2] 35,000	59,195
Michigan					(1)	(1)
Minnesota					313,130	174,720
New Jersey						1,049
New York					(1)	3,764,629
Ohio					2,024,334	6,322,964
Pennsylvania						19,075,167
Tennessee			8,959			
Utah		14,269				
Washington						
West Virginia						1,411,524
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin					(1)	6,098
Undistributed					2,818,812	129,558
	6,469,460	1,030,095	8,959	561,600	9,199,256	32,226,533

State where coal was used	Coal produced in—						
	Tennessee	Utah	Virginia [3]	Washington	West Virginia [3]	Miscellaneous	Total [4]
Alabama					115,351		6,584,811
Colorado							1,015,826
Illinois			(1)		2,294,842		4,744,813
Indiana					5,205,275		8,204,220
Maryland					1,085,920		1,635,668
Massachusetts			277,019		655,827		1,027,041
Michigan					1,856,670		3,944,870
Minnesota					412,088		899,938
New Jersey			499,879		713,510		1,214,438
New York			(1)		996,180		5,482,910
Ohio					3,127,760		11,475,058
Pennsylvania					1,250,495		20,325,662
Tennessee	129,148						138,107
Utah		435,385					449,654
Washington				64,458			64,458
West Virginia					554,840		1,966,364
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin			(1)		1,395,335	5,685	1,989,793
Undistributed			592,061				
	129,148	435,385	1,368,959	64,458	19,664,093	5,685	71,163,631

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[1] Included under "Undistributed."

[2] Partly estimated.

[3] Coal from the extension of the Pocahontas field in Tazewell County, Va., is included under West Virginia.

[4] Difference between these totals and those shown in Tables 3, 30, etc., is due to change in stock, loss of weight in handling, and to the fact that these sometimes represent purchases made during the year rather than actual consumption.

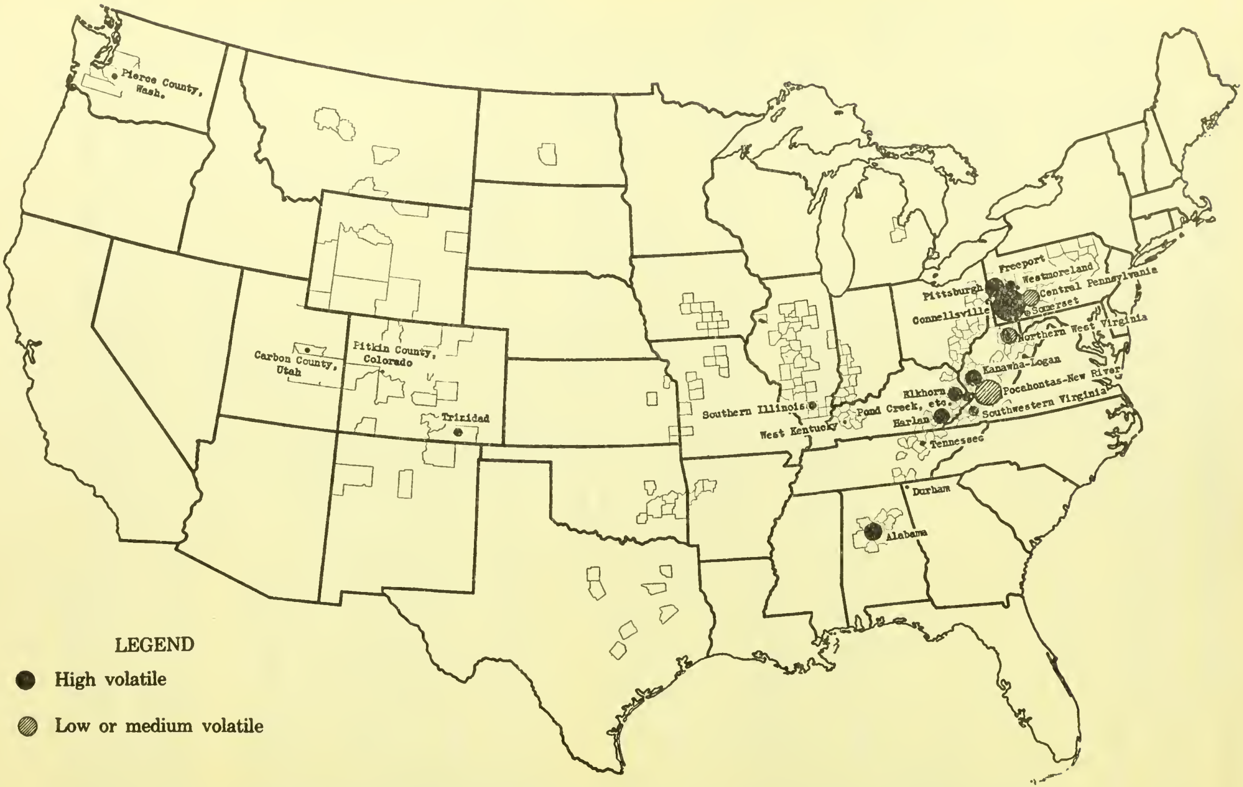
Pierce County, Wash.
Carbon County, Utah
Pitkin County, Colorado
Trinidad
Southern Illinois
West Kentucky
Pond Creek, etc.
Harlan
Elkhorn
Tennessee
Durham
Alabama
Pittsburgh
Freeport
Westmoreland
Central Pennsylvania
Connellsville
Somerset
Northern West Virginia
Kanawha-Logan
Pocahontas-New River
Southwestern Virginia
LEGEND
● High volatile
▨ Low or medium volatile

FIGURE 43.—Sources of coal charged in by-product coke ovens in 1928, by field where mined. Size of circles is proportionate to tonnage. Note heavy concentration of tonnage from the northern and middle Appalachians and the small amounts derived from the middle western fields

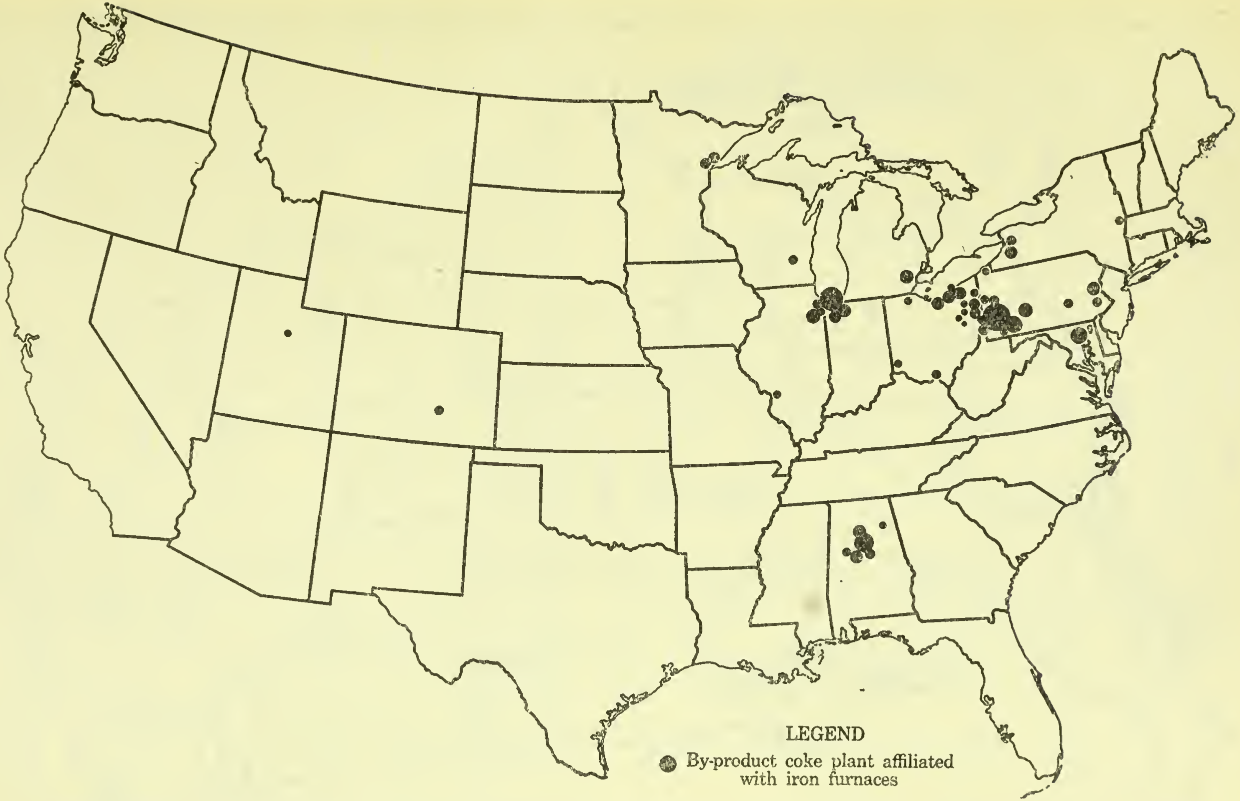
LEGEND
● By-product coke plant affiliated with iron furnaces

FIGURE 44.—Location and capacity of furnace by-product coke plants. Size of circles is proportionate to annual capacity of coke as reported by Iron Age. In the crowded districts of Pittsburgh, Birmingham, and Chicago the location of the dots is approximate only

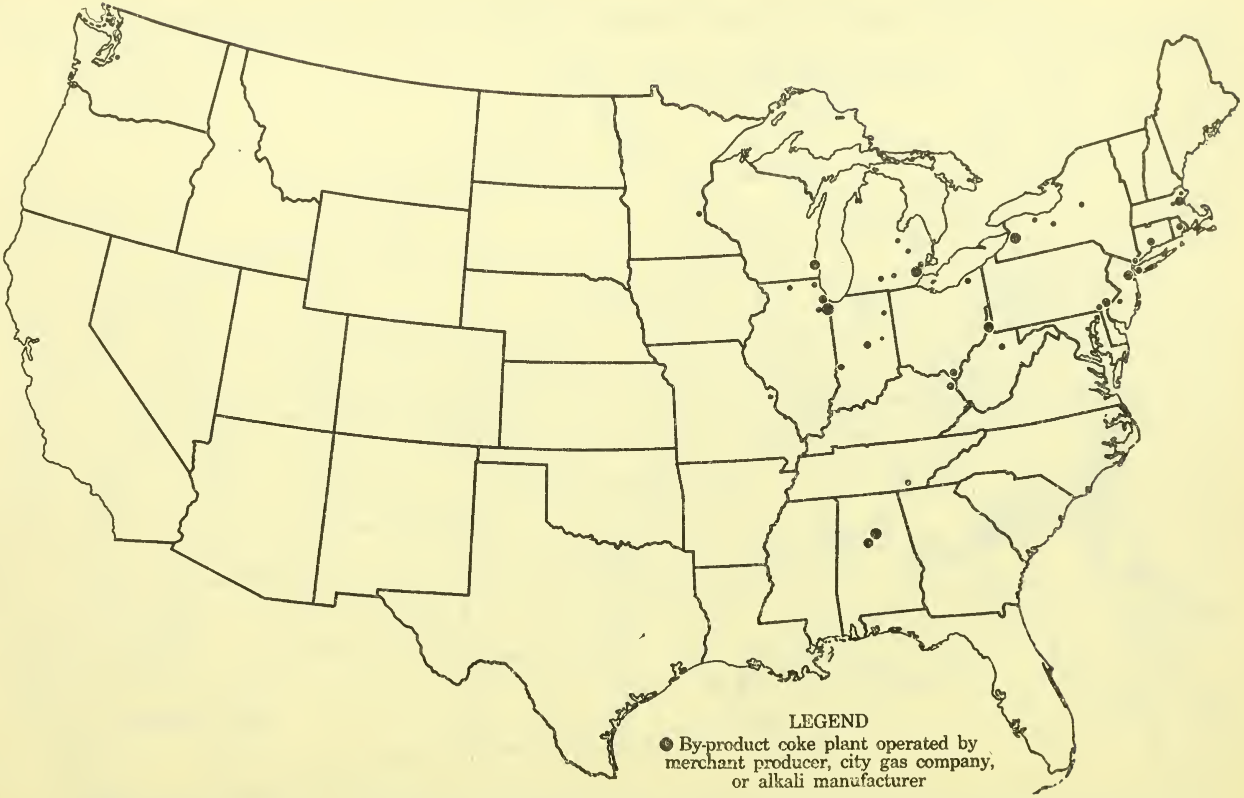
LEGEND
● By-product coke plant operated by merchant producer, city gas company, or alkali manufacturer

FIGURE 45.—Location and capacity of nonfurnace or merchant by-product coke plants. The scale is the same as in the map of the furnace plants

YIELD OF COKE PER TON OF COAL

TABLE 36.—*Percentage yield of coke from coal in by-product and beehive ovens, by States, 1925–1928*

State	1925		1926		1927		1928	
	By-product	Beehive	By-product	Beehive	By-product	Beehive	By-product	Beehive
Alabama	70.3	64.4	70.3	(1)	70.4	----------	69.6	----------
Colorado	69.3	64.8	69.0	64.2	68.5	64.8	68.0	65.4
Georgia	----------	56.9	----------	59.7	----------	(1)	----------	(1)
Illinois	71.3	----------	70.8	----------	69.0	----------	68.8	----------
Indiana	74.9	----------	74.9	----------	74.5	----------	74.3	----------
Kentucky	(1)	61.1	(1)	59.0	(1)	(1)	(1)	(1)
Maryland	73.4	----------	73.1	----------	73.0	----------	72.5	----------
Massachusetts	67.1	----------	65.6	----------	68.1	----------	66.4	----------
Michigan	71.5	----------	72.4	----------	71.3	----------	70.6	----------
Minnesota	65.4	----------	68.6	----------	68.8	----------	69.2	----------
New Jersey	72.8	----------	72.5	----------	72.8	----------	72.1	----------
New Mexico	----------	61.4	----------	(1)	----------	----------	----------	----------
New York	72.2	----------	71.6	----------	70.4	----------	69.1	----------
Ohio	68.7	64.8	68.9	67.5	68.9	(1)	67.9	(1)
Pennsylvania	67.1	65.7	66.3	65.6	66.3	65.5	66.3	65.4
Tennessee	70.6	63.7	71.9	56.8	75.3	56.4	74.7	59.8
Utah	53.2	59.0	56.6	59.6	61.9	59.7	55.0	57.7
Virginia	----------	63.8	----------	61.8	----------	60.0	----------	58.9
Washington	59.3	61.5	63.0	62.9	62.5	64.0	63.2	63.9
West Virginia	69.2	60.9	69.2	61.0	67.6	58.7	69.5	58.8
Average	69.9	65.2	69.7	65.0	69.4	64.3	68.9	64.0

[1] Not at liberty to publish data.

COKE BREEZE

The manufacture of coke produces appreciable percentages of coke breeze or screenings too fine for metallurgical or household use. Logically this material, which probably averages somewhat more than 12,000 B.t.u. per pound on a dry basis, should be considered part of the coke production because of its value as a fuel. Inclusion of this material, however, would not conform to the general trade usage. Moreover, present and past production could not then be accurately compared, for statistical records of breeze produced before 1916 are fragmentary. Hence, breeze is treated in this report as a by-product, and the term "coke" refers only to the larger material from which the screenings have been removed. The size of the material classed as breeze varies with the different plants, but it may be described roughly as corresponding to the steam sizes of anthracite. Table 37 indicates that in the beehive branch of the industry the problem of finding a profitable outlet for breeze remains unsolved. The quantity reported as produced in 1928 was only 131,873 tons, a small part of the total quantity of fine material resulting from the carbonization of the coal charged during the year. Limited amounts of the breeze produced in beehive ovens are used by the producer for steam raising and other purposes, and even smaller quantities are sold.

Uses can ordinarily be found for the breeze produced at by-product coke plants, and the amount wasted is negligible. As the low value per ton will not justify long hauls, breeze is generally used at or near the producer's plant. Approximately 80 per cent of the breeze obtained at by-product plants in 1928 was consumed by the producer, generally as a boiler fuel. The remainder was sold to near-by consumers. By-product breeze is also utilized frequently as a fuel for gas producers, especially when the surplus gas of the plant is sold for city use, the producer gas being employed to heat the ovens.

TABLE 37.—*Coke breeze recovered at coke plants, by States, in 1928*

State	Yield (per cent of coal)	Produced		Used for steam raising		Used for other purposes by producer		Sold		On hand Dec. 31 (net tons)	Wasted (net tons)
		Net tons	Value	Net tons	Value	Net tons	Value	Net tons	Value		
By-product ovens:											
Alabama	4.4	275,637	$456,989	166,189	$274,174	21,980	$59,792	56,292	$72,468	63,024	(1)
Colorado	6.0	53,067	(1)	36,050	(1)	12,526	(1)	----------	----------	4,491	----------
Illinois	5.6	263,212	663,968	184,517	448,384	14,515	36,395	89,020	235,838	94,923	----------
Indiana	5.2	422,823	1,079,640	298,294	742,383	49,274	91,123	40,134	157,353	49,433	----------
Maryland	6.6	107,620	(1)	56,429	(1)	32,477	(1)	38,202	(1)	14,162	----------
Massachusetts	6.9	71,169	228,353	12,579	40,565	12,528	48,718	44,946	135,862	5,905	----------
Michigan	5.9	199,005	551.862	156,372	430,896	3,488	13,255	25,239	75,019	48,641	----------
Minnesota	7.0	63,057	193,029	38,755	105,385	(1)	(1)	6,762	29,499	6,442	----------
New Jersey	3.7	46,294	(1)	42,620	(1)	----------	----------	331	(1)	5,043	----------
New York	5.4	297,280	748,291	203,980	468,617	56,376	231,350	49,487	93.789	24,186	(1)
Ohio	7.6	877,453	1,890,554	567,017	1,001,577	41,257	89,162	246,944	751,309	71,729	----------
Pennsylvania	6.8	1,390,221	2,485,553	1,147,451	1,907,425	81,208	159,771	158,515	412,999	14,200	----------
Tennessee	4.5	6,776	18,160	5,530	14,817	----------	----------	----------	----------	4,856	----------
Utah	9.0	40,491	(1)	----------	----------	----------	----------	45,356	(1)	25,277	----------
Washington	6.1	3,926	3,926	3,889	3,889	----------	----------	37	37	----------	----------
West Virginia	5.2	101,665	124,250	77,016	89,408	(1)	(1)	23,958	34,384	13,617	----------
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	7.9	158,543	440,364	136,141	288,242	27,386	139.521	4,912	11.563	12,930	----------
Undistributed	----------	----------	606,103	----------	291,305	11,816	135,157	----------	259,825	----------	24,032
	6.2	4,378,239	9,491,042	3,132,829	6,107,067	364,831	1,004,244	830,135	2,269,945	458,859	24,032
Beehive ovens:											
Colorado	[2] 3.4	6,590	10,487	----------	----------	----------	----------	6,614	10,501	----------	----------
Ohio, Tennessee, and Virginia	[2] 1.9	8,793	14,930	3,400	3,012	111	416	5,236	11,329	50	----------
Pennsylvania	[2] 3.4	107,506	139,190	19,197	19,018	1,604	3,077	13,568	23,138	66,326	20,546
West Virginia	[2] 3.6	8,984	9,288	5,190	2,595	----------	----------	3,744	6,627	----------	50
	[2] 3.3	131,873	173,895	27,787	24,625	1,715	3,493	29,162	51,595	66,376	[3] 20,596

[1] Included under "Undistributed."

[2] Yield computed by dividing the production of the breeze at the few plants reporting by the quantity of coal charged at these plants.

[3] As reported; quantity produced but not used was undoubtedly greater. See Mineral Resources, 1922, Pt. II, pp. 726–727.

FURNACE, FOUNDRY, AND OTHER COKE

SOURCE OF INFORMATION

Tables 38 to 41 analyze the replies of the producers to the following questions:

Disposal of large coke

	Net tons	Value at ovens
Used by producer, not sold:		
In blast furnaces	------	$----------
In other affiliated works	------	----------
Sold for furnace use (metallurgical only):		
To financially affiliated corporations	------	----------
To other merchant consumers	------	----------
Sold for foundry use	------	----------
Sold for domestic use	------	----------
Sold for industrial and other use	------	----------

These questions have been used substantially without change since 1923. In 1928, however, for the first time the tonnage used by the producer was segregated between coke consumed in blast furnaces and that used for other purposes.

BY-PRODUCT COKE DISTRIBUTED IN 1928

In 1928 the producers of by-product coke reported sales of 14,317,383 tons, of which 3,136,547 tons was furnace coke sold to affiliated corporations, 1,652,531 tons furnace coke to nonaffiliated purchasers (merchant sales), 1,955,294 tons foundry coke, 1,318,629 tons coke for other industrial uses, including the manufacture of water gas, and 6,254,382 tons sold for domestic use. (See Table 38.) The quantity not sold but used by the producers themselves was 33,938,915 tons. Of this 32,942,532 tons was used in the blast furnaces and 996,383 tons in other affiliated works. Chief among these other uses was the manufacture of alkali products and the generation of water gas at plants supplying coke-oven gas for city distribution.

TABLE 38.—*By-product coke produced and sold or used by the producer, by States, in 1928*

[Exclusive of screenings and breeze]

State	Produced		Used by producer in blast furnace, etc.		Sold									
					Furnace[1]		Foundry		Other industrial use (including water gas)		Domestic use		Total	
	Net tons	Value	Net tons	Value	Net tons	Value	Net tons	Value	Net tons	Value	Net tons	Value	Net tons	Value
Alabama	4,327,324	$13,260,178	3,412,132	$9,719,349	(2)	(2)	411,670	$1,855,772	(2)	(2)	352,470	$1,170,007	800,605	$3,202,266
Colorado	605,822	(2)	607,132	(2)	----------	----------	----------	----------	10,301	(2)	68	(2)	10,369	(2)
Illinois	3,240,964	19,967,463	1,888,276	11,341,743	274,278	$1,564,589	(2)	(2)	(2)	(2)	739,408	4,845,910	1,285,638	8,338,089
Indiana	6,094,201	38,237,790	5,397,797	33,983,913	----------	----------	275,249	2,080,573	26,812	$167,854	420,535	2,061,630	722,596	4,310,057
Maryland	1,186,398	(2)	1,090,870	(2)	----------	----------	----------	----------	86,368	(2)	1,900	(2)	88,268	(2)
Massachusetts	687,356	5,269,890	15,127	95,857	(2)	(2)	(2)	(2)	91,071	(2)	247,128	2,036,225	684,635	5,239,112
Michigan	2,399,656	13,461,466	495,668	1,861,898	(2)	(2)	80,390	684,412	(2)	(2)	1,530,400	9,375,730	1,971,446	11,980,239
Minnesota	622,696	5,816,566	292,757	2,583,671	(2)	(2)	----------	----------	(2)	(2)	(2)	(2)	271,620	2,639,660
New Jersey	903,177	(2)	90,230	(2)	----------	----------	77,197	(2)	349,950	(2)	370,959	(2)	798,106	(2)
New York	3,802,657	25,033,649	1,350,074	8,972,393	1,102,526	6,430,579	(2)	(2)	(2)	(2)	995,706	7,096,769	2,454,305	16,124,983
Ohio	7,786,199	33,908,863	6,222,552	26,785,216	860,114	4,142,169	184,077	1,227,038	88,870	384,006	520,695	1,983,018	1,653,756	7,736,231
Pennsylvania	13,475,349	51,132,406	11,697,932	43,674,050	1,597,670	6,538,630	(2)	(2)	(2)	(2)	81,537	371,827	1,778,092	7,438,357
Tennessee	113,134	606,398	----------	----------	42,951	193,280	23,722	118,610	----------	----------	26,233	186,515	92,906	498,405
Utah	246,503	(2)	161,741	(2)	81,231	(2)	3,232	(2)	----------	----------	----------	----------	84,463	(2)
Washington	40,755	285,285	38,352	268,457	----------	----------	----------	----------	----------	----------	4,623	32,361	4,623	32,361
West Virginia	1,367,481	3,761,460	1,147,803	2,916,400	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	233,986	(2)
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	1,413,353	9,682,047	30,472	209,380	205,467	990,089	368,046	2,850,590	147,229	1,092,136	661,227	4,381,189	1,381,969	9,314,004
Undistributed	----------	16,091,743	----------	8,544,301	624,841	4,042,917	531,711	4,828,412	518,028	7,034,858	301,493	5,418,634	----------	8,332,565
	48,313,025	236,515,204	[3] 33,938,915	[3] 150,956,628	4,789,078	23,902,253	1,955,294	13,645,407	1,318,629	8,678,854	6,254,382	38,959,815	14,317,383	85,186,329

[1] Includes 3,136,547 tons, valued at $15,007,542, sold to affiliated corporations and 1,652,531 tons, valued at $8,894,711, reported as merchant sales.

[2] Included under "Undistributed."

[3] Includes 996,383 tons, valued at $5,718,760, used in affiliated works, not blast furnaces

BEEHIVE COKE DISTRIBUTED IN 1928

Corresponding data for beehive coke are given in Table 39. In 1928 the total sales amounted to 4,132,109 tons, including 808,123 tons of furnace coke sold to affiliated corporations; 2,045,591 tons of "merchant sales" for furnace use; 755,312 tons for foundry use; 445,745 tons for other industrial uses, including manufacture of water gas; and 78,338 tons for domestic use. The quantity of beehive coke used by the producers themselves was 370,629 tons, of which all but 3,315 tons was consumed in iron blast furnaces.

TABLE 39.—*Beehive coke produced and sold or used by the producer, by States, in 1928*

[Exclusive of screenings and breeze]

State	Produced		Used by producer in blast furnace, etc.[1]		Sold									
					Furnace[2]		Foundry		Other industrial use (including water gas)		Domestic use		Total	
	Net tons	Value	Net tons	Value	Net tons	Value	Net tons	Value	Net tons	Value	Net tons	Value	Net tons	Value
Colorado	144,200	(3)	21,077	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	122,214	(3)
Pennsylvania	3,442,006	$11,515,366	126,496	$502,697	2,548,504	$8,346,524	537,099	$2,368,352	172,517	$526,053	69,504	$237,668	3,327,624	$11,478,597
Tennessee	103,791	457,489	(3)	(3)	27,144	105,448	(3)	(3)	----------	----------	----------	----------	33,246	137,173
Utah	28,097	(3)	----------	----------	28,084	(3)	----------	----------	(3)	(3)	----------	----------	28,097	(3)
Virginia	247,734	1,052,016	(3)	(3)	(3)	(3)	94,994	414,506	123,533	530,806	(3)	(3)	245,893	1,042,553
Washington	18,747	151,902	----------	----------	----------	----------	----------	----------	18,747	151,902	----------	----------	18,747	151,902
West Virginia	431,419	1,543,933	74,732	310,065	137,839	461,891	114,045	468,133	104,337	301,461	479	2,248	356,700	1,233,733
Georgia, Kentucky, and Ohio	76,809	406,691	(3)	(3)	----------	----------	588	4,179	----------	----------	----------	----------	588	4,179
Undistributed	----------	1,191,159	148,324	845,355	112,143	885,307	8,586	51,288	26,611	205,456	8,355	55,988	----------	1,069,073
	4,492,803	16,318,556	370,629	1,658,117	2,853,714	9,799,170	755,312	3,306,458	445,745	1,715,678	78,338	295,904	4,133,109	15,117,210

[1] Includes 3,315 tons, valued at $15,564, used in affiliated works, not blast furnaces.
[2] Includes 808,123 tons, valued at $3,099,214, sold to affiliated corporations and 2,045,591 tons, valued at $6,699,956, reported as merchant sales.
[3] Included under "Undistributed."

RELATIVE GROWTH OF FURNACE, FOUNDRY, AND DOMESTIC COKE

In gaging the future demand for coke it is important to distinguish between the consumption for metallurgical purposes and that for other industrial and domestic uses. In general, the consumption of metallurgical coke has shown little growth in recent years, whereas the domestic consumption has been steadily increasing. Tables 40 and 41 indicate the relative growth of the demand for furnace, foundry, and domestic uses over as long a period as possible. Table 40 shows the sales so classified and the quantity used by the producer for each year from 1918 to 1928. From 1918 to 1922 the operators were merely asked to state the total quantity of furnace, of foundry, and of domestic coke sold. From 1923 to 1928 the figures of sales are based on replies to detailed questions substantially as listed on page 745. The change in form of inquiry affects the comparability of the figures before 1923, but from 1923 to 1928 they are entirely comparable. The movement of prices for the several grades of coke is indicated by the figures of average value per ton at the bottom of Table 40. (See also fig. 55.)

TABLE 40.—*Coke used by producer and sold for furnace, foundry, other industrial, and domestic use, 1918–1928*

[Exclusive of screenings and breeze]

Year	Used by producer in blast furnace or other affiliated works	Sold					
		Furnace		Foundry	Other industrial use (including water gas)	Domestic use	Total sales
		To affiliated corporations	Merchant sales				
Quantity (net tons):							
By-product—							
1918	17,753,348	4,147.695		1,631,052	2,537,059		8,315,806
1919	17,767,066	4,677,497		1,480,516	2,885,270		9,043,283
1920	22,848,461	4,054.964		1,715,982	2,361,737		8,132,683
1921	13,470,396	2,593,318		736,391	1,679,911		5,009,620
1922	21,106,823	2,934,924		1,601,733	3,865,751		8,402,408
1923	27,055,397	2,313.412	1,460,538	1,897,955	1,638,226	2,637,518	9,947.649
1924	24,023,933	2,335,056	1,590,983	1,553,849	1,556,175	2,812,771	9,848,834
1925	28,223,838	2,641,729	1,736,112	1,833,372	2,072,635	4,085,068	12,368,916
1926	31,334,305	2,127,176	1,566,980	2,168,017	1,662,837	5,056,568	12,581,578
1927	30,687,198	2,959,247	967,277	1,938,653	2,022,838	4,702,529	12,590,544
1928	33,938,915	3,136,547	1,652,531	1,955,294	1,318,629	6,254,382	14,317,383
Beehive—							
1918	4,885,318	23,216,627		2,230,156	210,511		25,657,294
1919	3,023,828	14,574,264		1,349,483	143,930		16,067,677
1920	3,204,884	15,188,814		1,807,256	192,142		17,188,212
1921	495,481	3,957,709		1,011,343	56,874		5,025,926
1922	1,071,886	6,105,003		1,164,716	179,670		7,449,389
1923	2,583,507	7,923,783	6,437,771	1,702,764	645,662	95,896	16,805,876
1924	1,574,037	3,582,004	3,357,433	1,363,952	260,046	139,886	8,703,321
1925	2,032,944	3,479,728	3,895,983	1,153,665	572,949	392,698	9,495,023
1926	1,575,039	4,260,028	4,156,032	1,163,660	963,797	386,045	10,929,562
1927	905,359	2,017,616	2,780,433	809,590	569,749	111,103	6,288,491
1928	370,629	808,123	2,045,591	755,312	445,745	78,338	4,133,109
Total—							
1918	22,638,666	27,364,322		3,861,208	2,747,570		33,973,100
1919	20,790,894	19,251,761		2,829,999	3,029,200		25,110,960
1920	26,053,345	19,243,778		3,523,238	2,553,879		25.320,895
1921	13,965,877	6,551,027		1,747,734	1,736,785		10,035.546
1922	22,178,709	9,039,927		2,766,449	4,045,421		15,851,797
1923	29,638,904	10,237,195	7,898,309	3,600,719	2,283,888	2,733,414	26,753,525
1924	25,597,970	5,917,060	4,948,416	2,917,801	1,816,221	2,952,657	18,552,155
1925	30,256,782	6,121,457	5,632,095	2,987,037	2,645,584	4,477,766	21,863,939
1926	32,909,344	6,387,204	5,723,012	3,331,677	2,626,634	5,442,613	23,511,140
1927	31,592,557	4,976,863	3,747,710	2,748,243	2,592,587	4,813,632	18,879,035
1928	34,309,544	3,944,670	3,698,122	2,710,606	1,764,374	6,332,720	18,450,492

TABLE 40.—*Coke used by producer and sold for furnace, foundry, other industrial, and domestic use, 1918–1928*—Continued

Year	Used by producer in blast furnace or other affiliated works	Sold					
		Furnace		Foundry	Other industrial use (including water gas)	Domestic use	Total sales
		To affiliated corporations	Merchant sales				
Total value:							
By-product—							
1918	(1)	$30, 792, 247		$15, 849, 017	$18, 907, 079		$65, 548, 343
1919	(1)	31, 028, 251		12, 865, 927	15, 607, 752		59, 501, 936
1920	(1)	42, 841, 222		23, 678, 225	21, 080, 429		87, 599, 870
1921	(1)	17, 202, 994		7, 662, 781	13, 809, 165		38, 674, 940
1922	(1)	20, 636, 494		15, 921, 431	34, 407, 054		70, 964, 979
1923	$168, 379, 600	$16, 307, 054	$9, 847, 055	19, 995, 342	$14, 845, 652	$23, 872, 007	84, 867, 110
1924	125, 838, 387	13, 495, 287	9, 149, 521	13, 425, 334	11, 854, 698	20, 063, 417	67, 988, 257
1925	134, 245, 288	13, 794, 422	9, 954, 964	14, 630, 450	14, 849, 829	28, 521, 425	81, 751, 090
1926	160, 606, 129	10, 955, 119	9, 800, 299	16, 836, 376	12, 285, 212	37, 567, 659	87, 444, 665
1927	145, 123, 216	15, 903, 197	5, 393, 276	15, 112, 967	13, 812, 393	32, 447, 939	82, 669, 772
1928	150, 956, 628	15, 007, 542	8, 894, 711	13, 645, 407	8, 678, 854	38, 959, 815	85, 186, 329
Beehive—							
1918	(1)	137, 782, 308		16, 802, 144	1, 319, 053		155, 903, 505
1919	(1)	72, 007, 820		8, 364, 256	775, 467		81, 147, 543
1920	(1)	108, 943, 650		17, 209, 737	1, 545, 147		127, 698, 534
1921	(1)	20, 979, 386		5, 932, 599	272, 412		27, 184, 397
1922	(1)	33, 724, 440		8, 334, 400	1, 086, 014		43, 144, 854
1923	14, 045, 646	45, 756, 993	39, 326, 693	12, 259, 196	4, 112, 236	461, 971	101, 917, 089
1924	7, 872, 356	17, 706, 496	13, 507, 138	7, 543, 143	1, 052, 249	509, 333	40, 318, 359
1925	9, 502, 959	16, 497, 801	15, 722, 122	5, 971, 595	2, 494, 947	2, 240, 546	42, 927, 011
1926	7, 148, 961	20, 306, 453	16, 384, 006	5, 967, 936	4, 638, 542	2, 677, 741	49, 974, 678
1927	4, 035, 732	9, 153, 274	10, 243, 163	4, 085, 876	2, 154, 443	446, 236	26, 082, 992
1928	1, 658, 117	3, 099, 214	6, 699, 956	3, 306, 458	1, 715, 678	295, 904	15, 117, 210
Total—							
1918	(1)	168, 574, 555		32, 651, 161	20, 226, 132		221, 451, 848
1919	(1)	103, 036, 071		21, 230, 183	16, 383, 219		140, 649, 473
1920	(1)	151, 784, 872		40, 887, 962	22, 625, 576		215, 298, 410
1921	(1)	38, 182, 380		13, 595, 380	14, 081, 577		65, 859, 337
1922	(1)	54, 360, 934		24, 255, 831	35, 493, 068		114, 109, 833
1923	182, 425, 246	62, 064, 047	49, 173, 748	32, 254, 538	18, 957, 888	24, 333, 978	186, 784, 196
1924	133, 710, 743	31, 201, 783	22, 656, 659	20, 968, 477	12, 906, 947	20, 572, 750	108, 306, 619
1925	143, 748, 247	30, 292, 223	25, 677, 086	20, 602, 045	17, 344, 776	30, 761, 971	124, 678, 101
1926	167, 755, 090	31, 261, 572	26, 184, 305	22, 804, 312	16, 923, 754	40, 245, 400	137, 419, 343
1927	149, 158, 948	25, 056, 471	15, 636, 439	19, 198, 843	15, 966, 836	32, 894, 175	108, 752, 764
1928	152, 614, 745	18, 106, 756	15, 594, 667	16, 951, 865	10, 394, 532	39, 255, 719	100, 303, 539
Value per ton:							
By-product—							
1918	(1)	7. 42		9. 72	7. 45		7. 88
1919	(1)	6. 63		8. 69	5. 41		6. 58
1920	(1)	10. 57		13. 80	8. 93		10. 77
1921	(1)	6. 63		10. 41	8. 22		7. 72
1922	(1)	7. 03		9. 94	8. 90		8. 45
1923	6. 22	7. 05	6. 74	10. 54	9. 06	9. 05	8. 53
1924	5. 24	5. 78	5. 75	8. 64	7. 62	7. 13	6. 90
1925	4. 76	5. 22	5. 73	7. 98	7. 16	6. 98	6, 61
1926	5. 13	5. 15	6. 25	7. 77	7. 39	7. 43	6. 95
1927	4. 73	5. 37	5. 58	7. 80	6. 83	6. 90	6. 57
1928	4. 45	4. 78	5. 38	6. 98	6. 58	6. 23	5. 95
Beehive—							
1918	(1)	5. 93		7. 53	6. 27		6. 08
1919	(1)	4. 94		6. 20	5. 39		5. 05
1920	(1)	7. 17		9. 52	8. 04		7. 43
1921	(1)	5. 30		5. 87	4. 79		5. 41
1922	(1)	5. 52		7. 15	6. 04		5. 79
1923	5. 44	5. 77	6. 11	7. 20	6. 37	4. 82	6. 06
1924	5. 00	4. 94	4. 02	5. 53	4. 05	3. 64	4. 63
1925	4. 67	4. 74	4. 04	5. 18	4. 35	5. 71	4. 52
1926	4. 54	4. 77	3. 94	5. 13	4. 81	6. 94	4. 57
1927	4. 46	4. 54	3. 68	5. 05	3. 78	4. 02	4. 15
1928	4. 47	3. 79	3. 28	4. 38	3. 85	3. 78	3. 66
Total—							
1918	(1)	6. 16		8. 46	7. 36		6. 52
1919	(1)	5. 35		7. 50	5. 41		5. 60
1920	(1)	7. 89		11. 61	8. 86		8. 50
1921	(1)	5. 83		7. 78	8. 11		6. 56
1922	(1)	6. 01		8. 77	8. 77		7. 20
1923	6. 15	6. 06	6. 23	8. 96	8. 30	8. 90	6. 98
1924	5. 22	5. 27	4. 58	7. 19	7. 11	6. 97	5. 84
1925	4. 75	4. 95	4. 56	6. 90	6. 56	6. 87	5. 70
1926	5. 10	4. 89	4. 58	6. 84	6. 44	7. 39	5. 84
1927	4. 72	5. 03	4. 17	6. 99	6. 16	6. 83	5. 76
1928	4. 45	4. 59	4. 22	6. 25	5. 89	6. 20	5. 44

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[1] No data.

TABLE 41.—*Recapitulation of total supply of coke classified as furnace, foundry, other industrial, and domestic, 1915–1928, in net tons*[1]

[Exclusive of screenings and breeze]

Year	Furnace (including all coke used by producer)[2]	Foundry	Other industrial and domestic			Total sold and used by producer[3]
			Other industrial (not including coke used by producer)	Domestic	Total	
By-product:						
1918	21,901,043	1,631,052	(4)	(4)	2,537,059	26,069,154
1919	22,444,563	1,480,516	(4)	(4)	2,885,270	26,810,349
1920	26,903,425	1,715,982	(4)	(4)	2,361,737	30,981,144
1921	16,063,714	736,391	(4)	(4)	1,679,911	18,480,016
1922	24,041,747	1,601,733	(4)	(4)	3,865,751	29,509,231
1923	30,829,347	1,897,955	1,638,226	2,637,518	4,275,744	37,003,046
1924	27,949,972	1,553,849	1,556,175	2,812,771	4,368,946	33,872,767
1925	32,601,679	1,833,372	2,072,635	4,085,068	6,157,703	40,592,754
1926	35,028,461	2,168,017	1,662,837	5,056,568	6,719,405	43,915,883
1927	34,613,722	1,938,653	2,022,838	4,702,529	6,725,367	43,277,742
1928	38,727,993	1,955,294	1,318,629	6,254,382	7,573,011	48,256,298
Beehive:						
1918	28,101,945	2,230,156	(4)	(4)	210,511	30,542,612
1919	17,598,092	1,349,483	(4)	(4)	143,930	19,091,505
1920	18,393,698	1,807,256	(4)	(4)	192,142	20,393,096
1921	4,453,190	1,011,343	(4)	(4)	56,874	5,521,407
1922	7,176,889	1,164,716	(4)	(4)	179,670	8,521,275
1923	16,945,061	1,702,764	645,662	95,896	741,558	19,389,383
1924	8,513,474	1,363,952	260,046	139,886	399,932	10,277,358
1925	9,408,655	1,153,665	572,949	392,698	965,647	11,527,967
1926	9,991,099	1,163,660	963,797	386,045	1,349,842	12,504,601
1927	5,703,408	809,590	569,749	111,103	680,852	7,193,850
1928	3,224,343	755,312	445,745	78,338	524,083	4,503,738
Total:						
1915	36,702,573	1,664,548	(4)	(4)	1,974,102	40,341,223
1916	47,875,153	2,680,104	(4)	(4)	2,616,320	53,171,577
1918	50,002,988	3,861,208	(4)	(4)	2,747,570	56,611,766
1919	40,042,655	2,829,999	(4)	(4)	3,029,200	45,901,854
1920	45,297,123	3,523,238	(4)	(4)	2,553,879	51,374,240
1921	20,516,904	1,747,734	(4)	(4)	1,736,785	24,001,423
1922	31,218,636	2,766,449	(4)	(4)	4,045,421	38,030,506
1923	47,774,408	3,600,719	2,283,888	2,733,414	5,017,302	56,392,429
1924	36,463,446	2,917,801	1,816,221	2,952,657	4,768,878	44,150,125
1925	42,010,334	2,987,037	2,645,584	4,477,766	7,123,350	52,120,721
1926	45,019,560	3,331,677	2,626,634	5,442,613	8,069,247	56,420,484
1927	40,317,130	2,748,243	2,592,587	4,813,632	7,406,219	50,471,592
1928	41,952,336	2,710,606	1,764,374	6,332,720	8,097,094	52,760,036

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[1] For 1915 and 1916 separate figures for by-product and beehive coke are not available; the total, however, is shown. For 1917 no data on this subject were collected.

[2] Sales of furnace coke plus the total quantity reported "used by producer." Includes coke consumed at associated iron and steel works for other than blast-furnace use and also a small quantity consumed for purposes that have no relation to the manufacture of iron and steel, such as alkali manufacture, smelting nonferrous metals, and making water gas and producer gas at plants supplying gas for city distribution. The quantity used for these other purposes in 1926 was about 429,000 tons of by-product coke and 26,000 tons of beehive coke.

[3] These figures represent the quantity distributed in the year without taking into account changes in producers' stocks and therefore differ slightly from the published totals of production. In 1915 and 1916, moreover, they do not include the quantity exported.

[4] Not separated prior to 1923.

Table 41 continues the analysis by grouping the sales of furnace coke and the quantity reported as "used by producer." The total thus obtained includes the small amount of coke used for other purposes than in iron blast furnaces, including coke used by the producer in smelting nonferrous metals, in alkali manufacture, and in the production of water gas. The exact amount of this additional tonnage was not ascertained prior to 1926, in which year it amounted to 429,000 tons of by-product coke and 26,000 tons of beehive coke. The quantity consumed for other purposes is thus not so great as to prevent using the total as a rough measure of the demand for furnace coke, but it should be borne in mind that the tonnage for other purposes has been gradually increasing.

In 1915 the demand for furnace coke calculated in this way and including both beehive and by-product coke was about 36,703,000 tons and in 1916 about 47,875,000 tons. In 1928 it was 41,952,000 tons, an increase over 1915 but a decrease when compared with 1916. On the whole, the demand for furnace coke during this period shows no consistent increase.

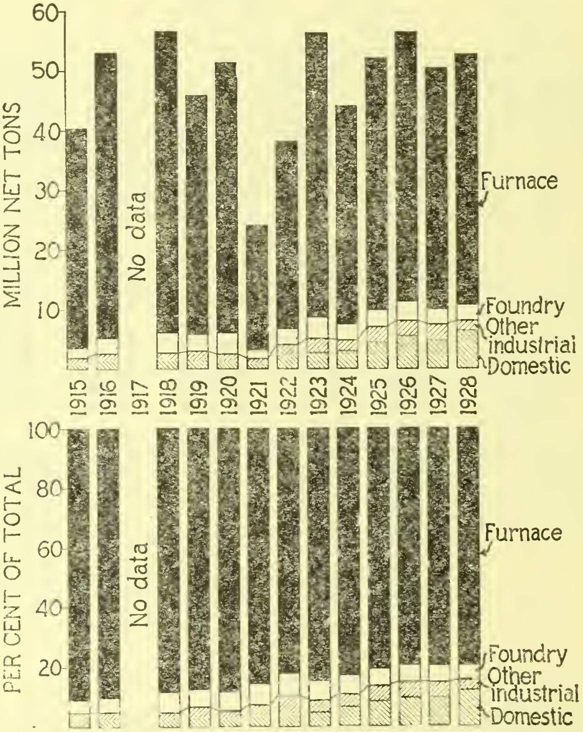

FIGURE 46.—By-product and beehive coke sold for furnace, foundry, other industrial, and domestic use. Data from Table 41. Figures for furnace coke include all coke used by producer and not sold. The data represent the disposition made of the total production including exports, except that in 1915 and 1916 the exports are not included

The sales of foundry coke, including both beehive and by-product coke, were 1,665,000 tons in 1915 and 2,680,000 tons in 1916, but as the figures for these two years do not include exports they are not strictly comparable with those for the rest of the period. In 1918 the total sales of foundry coke, including the exports, were 3,861,000 tons; in comparison, the sales of 2,711,000 in 1928 show a decrease. It therefore appears that the demand for foundry coke also has shown no marked change during the last decade.

In contrast with the stationary demand for metallurgical coke the quantities sold for domestic and miscellaneous industrial uses have increased three to four fold during the same period. Total sales for domestic and miscellaneous industrial uses in 1916, including both beehive and by-product coke but excluding the small amount exported, were 2,616,000 tons. In 1918, including the exports, they were 2,748,000 tons, from which they increased to 8,097,000 in 1928.

Beginning with 1923, the miscellaneous industrial sales can be segregated from the sales for domestic purposes, and the growth of the domestic demand can be measured exactly. In 1923, a year when supplies of anthracite were limited, the sales of coke for domestic purposes, including beehive coke, totaled 2,733,000 tons. In 1928 they were 6,333,000 tons.

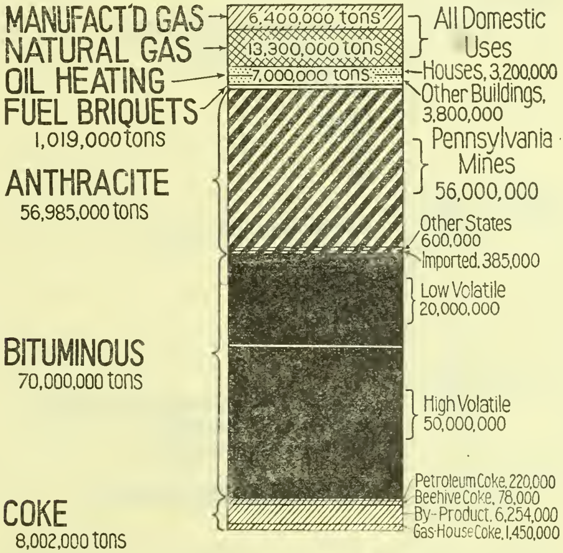

FIGURE 47.—Fuels consumed for domestic heating and cooking in the United States, 1928. The total consumption of fuel for domestic purposes is equivalent to 162,706,000 net tons of coal. The figure includes the coal equivalent of oil and gas. It includes also fuel for heating large buildings other than factories. The figures for some of the items, especially bituminous coal, are necessarily rough estimates but will serve to indicate the relative importance of the several fuels and the enormous size of the domestic heating market

DOMESTIC COKE

The rapid increase in the use of coke for house fuel when the demand for metallurgical coke shows no consistent growth is reflected in widespread interest in the possibilities of the domestic market.

It is seldom realized that in the aggregate the consumption of fuel for heating buildings is the largest single item in the national demand for energy, exceeding even the requirements of the railroads. The total consumption of fuel for domestic purposes is equivalent to

163,000,000 tons of coal a year. This figure includes fuel for heating large buildings other than factories, and it includes the coal equivalent of oil and gas. Of this enormous total 27,000,000 tons is the equivalent of liquid or gas and 136,000,000 tons is solid fuel. The elements making up the total are shown graphically in Figure 47. The figures for some of the items, especially bituminous coal, are necessarily rough estimates, but they will serve to indicate the relative importance of the several fuels and the enormous size of the domestic heating market.

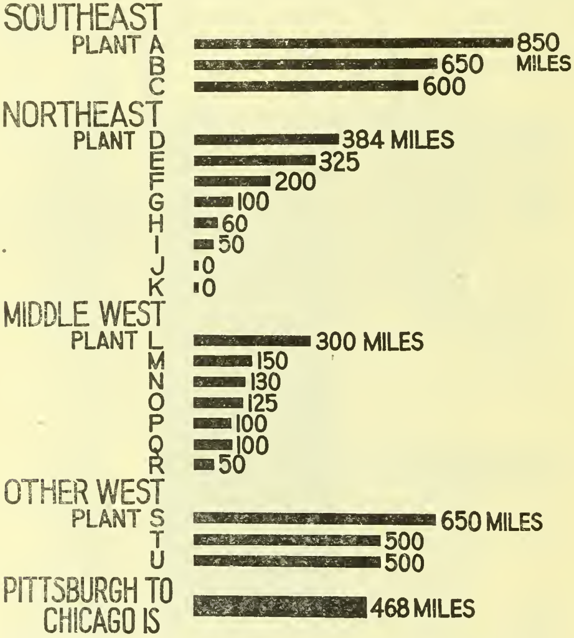

FIGURE 48.—Maximum distance that domestic by-product coke is shipped. The figures represent the experience of 21 merchant by-product coke plants in the year 1927 and illustrate the wide radius of the potential market for coke. A number of the plants make occasional shipments at distances greater than the 468 miles from Pittsburgh to Chicago

The domestic market is not only large, but it is growing. The increase is partly due to the growth of population; but per capita consumption is also increasing, having grown about 20 per cent in the last 20 years.

As a consumer the householder is naturally conservative, and in the past the domestic demand has been slow to change, but the tendencies toward mechanization and the interplay of competition, which are increasingly conspicuous in other business, have made their appearance in the field of domestic heating as well. The domestic market now shows three distinct tendencies: An increasing proportion of the population is living and working in large buildings that can readily be heated by central heating installations; there is an increasing demand for fuels that will not smoke; and, perhaps most important, the consumer is beginning to appreciate the luxury of automatic heating with oil, gas, and small automatic stokers adapted to solid fuels.

The competitive nature of the domestic market is indicated by the figures in Table 42, which show the supplies of the several fuels available for or actually used for domestic purposes in the last four years. (Corresponding figures for 1924 are given in Coke and By-Products in 1927, p. 636.)

TABLE 42.—*Total supplies of fuels used for domestic purposes in the United States, 1925–1928*

[The figures for 1925 and 1926 were affected by the great strike of the anthracite miners which lasted from Sept. 1, 1925, to Feb. 18, 1926]

	1925	1926	1927	1928
Solid fuels (net tons)				
Pennsylvania anthracite production:				
Shipments of domestic sizes	38,305,222	54,096,437	48,999,058	46,218,403
Shipments of buckwheat No. 1 [1]	6,631,604	8,581,966	9,062,977	8,769,923
Shipments of smaller steam sizes	8,831,546	12,640,417	12,433,251	11,499,274
Local sales	2,884,577	2,687,411	3,046,770	3,184,825
Total commercial production	56,652,949	78,006,231	73,542,056	69,672,425
Anthracite exported	3,179,006	4,029,683	3,325,507	3,336,272
Anthracite imported, chiefly from United Kingdom	382,894	813,956	119,030	384,707
Fuel briquets produced	839,370	995,332	970,468	947,423
Fuel briquets imported	6,758	123,593	60,601	71,485
By-product coke sold for domestic use	4,085,068	5,056,568	4,702,529	6,254,382
Beehive coke sold for domestic use	392,698	386,045	111,103	78,338
Coke imported	201,579	284,548	168,859	147,701
Gas-house coke sold [2]	1,368,704	1,400,000	1,484,268	1,450,000
Petroleum coke produced [3]	991,000	995,300	1,145,200	1,426,600
Anthracite and semianthracite produced outside of Pennsylvania	786,594	843,125	651,869	712,406
Bituminous coal for domestic use [4]	(5)	(5)	(5)	(5)
Oil (barrels)				
Oil used for heating houses [6]	5,000,000	9,080,000	[7] 11,709,000	13,967,000
Oil used for heating offices, hotels, apartments, schools, hospitals, and buildings other than houses	[8] 12,100,000	[7] 13,874,000	[7] 15,751,000	16,704,000
Gas (million cubic feet)				
Natural gas consumed for domestic use	272,146	289,175	296,036	320,877

[1] A considerable part of the buckwheat No. 1 is used for domestic purposes.

[2] See Table 5. Figures for 1928 are subject to revision.

[3] How much petroleum coke was used for house fuel prior to 1928 is not known. For that year 235,000 tons was reported to have been consumed in domestic heating, according to a study made by E. B. Swanson, U. S. Bureau of Mines.

[4] During the anthracite strike about 17,000,000 tons of bituminous coal in addition to the normal consumption was used to replace anthracite.

[5] Between 56,000,000 and 77,000,000 tons a year.

[6] Based on surveys by E. B. Swanson, U. S. Bureau of Mines. See National Survey of Fuel-Oil Distribution, 1928, pp. 16–18. Figures for 1925 relate to the heating season of 1924–25. The figures for 1926, 1927, and 1928 represent the calendar year.

[7] Revised figures.

[8] Partly estimated.

Active competition between the several fuels is forcing down prices. Prices of bituminous coal, briquets, and fuel oil are falling. Prices of anthracite have declined since 1926. The average sales realizations on domestic by-product coke have declined from $7.13 in 1924 to $6.23 in 1928. Details are given in Table 43 and Figure 50.

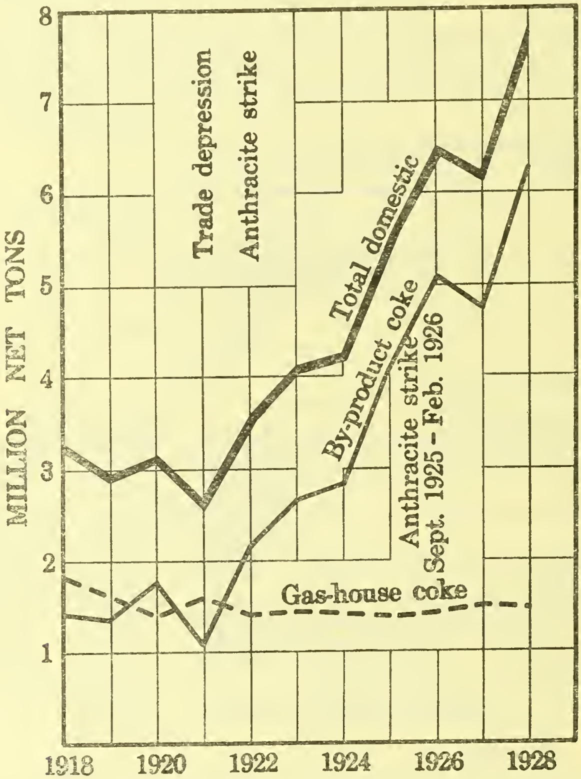

FIGURE 49.—Growth of sales of domestic by-product coke and gas-house coke, 1918–1928. The figures of by-product coke for 1918 to 1922 exclude noncommercial deliveries of small coke to the employees of certain steel companies and are not strictly comparable with those for later years. The discrepancy, however, is immaterial. The figures for gas-house coke represent all coke sold by city gas companies, except that made in by-product ovens

Pressure on the domestic price structure is coming from five sources, all of which are seeking outlets:

1. Surplus of natural gas in the Southwest.
2. Surplus of fuel oil.
3. New by-product coke plants.
4. 10,000,000 tons of unused Pennsylvania anthracite capacity.
5. 40,000,000 tons of unused bituminous capacity (prepared sizes only).

Further expansion of facilities and future merchandising policies of each of the fuel industries must necessarily reckon with this situation.

TABLE 43.—*Price trends of domestic by-product coke and of other fuels suitable for household use, 1921–1928*

	Unit	Average price per unit							
		1921	1922	1923	1924	1925	1926	1927	1928
By-product coke, f. o. b. ovens:									
Sales for domestic and miscellaneous industrial use [1]	Net ton	$8.22	$8.90	$9.06	$7.31	$7.04	$7.42	$6.88	$6.29
Sales for domestic use	do	(1)	(1)	9.05	7.13	6.98	7.43	6.90	6.23
Domestic anthracite, f. o. b. mines Pennsylvania, average realization on breaker shipments [2]	Gross ton	7.39	7.77	8.23	8.25	8.30	8.66	8.33	8.09
Fuel briquets, Central States, f. o. b. plants	Net ton	9.28	9.02	9.35	9.00	8.72	8.86	8.30	8.38
Cost of coking coal delivered at by-product plants	do	4.84	4.73	4.76	4.13	3.86	3.88	3.87	3.57
Low-volatile bituminous coal, f. o. b. mines [3]	do	3.00	2.74	3.16	1.96	1.90	2.04	1.93	1.75
Hard coal produced outside Pennsylvania	do	5.40	5.75	5.34	4.70	4.41	4.57	4.46	4.19
Burning oil, domestic, f. o. b. refinery, Oklahoma	Gallon	(4)	(4)	.033	.037	.037	.048	.036	.032
Natural gas, domestic use, at point of consumption	M cu. ft.	.444	.499	.514	.540	.560	.584	.608	.620

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[1] Until 1923 the sales for miscellaneous industrial use (a small item) were combined with those for domestic use.

[2] Includes pea and all larger sizes.

[3] Average (unweighted) of the average sales realization of operators in McDowell, Mercer, and Raleigh Counties, W. Va.

[4] No data.

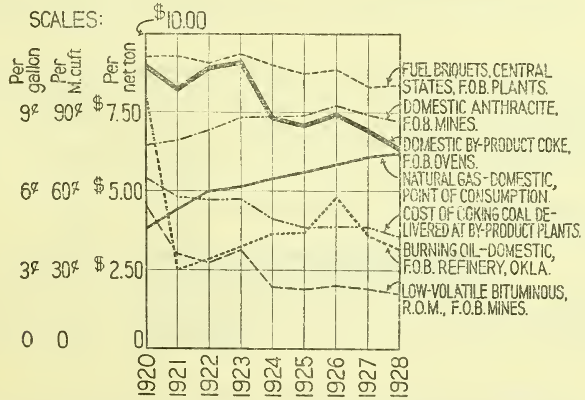

FIGURE 50.—Price trends of domestic fuels, 1920–1928. All but one of the seven fuels shown have declined in price since 1926, the single exception being natural gas. All but two had also declined from 1920 to 1926. As the figures are not retail prices, they do not show comparative costs to the consumer

The place of coke in the domestic fuel market is still small. The total sales of coke of all kinds for domestic use amounted to 8,018,000 tons in 1928, hardly 5 per cent of the domestic fuel budget of the country. Table 44 classifies this 8,018,000 by kind of coke and type of producing interest. According to E. B. Swanson 235,000 tons of petroleum coke was used as domestic fuel. Beehive coke ovens furnished an additional 78,000 tons. The tonnage of gas-house coke reaching the market was approximately 1,450,000 tons, and as already pointed out this includes not only the product of horizontal retorts but considerable tonnages of coke from vertical retorts and from small horizontal gas ovens. The great bulk of the supply came from the by-product coke ovens, the total from this source being 6,254,000 tons. Of this 1,544,000 tons came from plants affiliated with iron furnaces and was distributed chiefly in the immediate vicinity of those plants. Plants engaged in supplying gas for city distribution, many of which are operated as public utilities, contributed 2,544,000 tons and other merchant plants supplied 2,167,000 tons.

The rapid growth of by-product oven coke for domestic use is shown in Figure 49.

TABLE 44.—*Coke sold for domestic use classified by type of producing interest*

Type of producing interest	Net tons sold		Average value at plant	
	1927	1928	1927	1928
Beehive oven coke	111,103	78,338	$4.02	$3.78
By-product oven coke:				
Plants affiliated with iron furnaces	868,079	[1] 1,543,801	5.71	[1] 5.48
Plants engaged largely in supplying gas for city distribution, frequently public utilities	2,169,674	2,543,533	8.02	7.59
Other merchant plants	1,664,776	2,167,048	6.07	5.17
Total by-product coke	4,702,529	6,254,382	6.90	6.23
Gas-house coke, including all types of carbonizing equipment other than by-product coke ovens[2]	1,484,268	1,450,000	(3)	(3)
Petroleum coke	(3)	235,000	(3)	(3)

[1] The large increase in tonnage from furnace by-product plants in 1928 came chiefly from interests affiliated with the automobile industry. Lessened activity in this industry threw a large tonnage of coke on the domestic market. This also affected the price.

[2] Includes sales for all purposes, most of which were doubtless domestic. Figure for 1928 estimated.

[3] No data.

The wide area of the by-product market is indicated by Figure 48. A group of 21 merchant plants reported shipments to distances as great as 600 or 800 miles from the plant. How large a profit remains to the producer after transportation costs on such great distances are absorbed is a question, but the figure illustrates the immense area over which coke is already distributed and suggests active competition between different shippers in the same consuming markets.

THE RETAIL DEALER AS A DISTRIBUTOR OF COKE

The policy of coke producers with respect to retailing differs widely. Some companies have found it necessary to develop their own retail departments; others have successfully utilized established retailers. So fortunate has this policy been in some localities that individual retailers report as much as 60 per cent of their total sales as coke. For the country as a whole, however, coke still forms a small part of the business of the typical retail coal merchant. Table 45, compiled by H. O. Rogers from reports from representative retailers, shows that for the country as a whole 63 per cent of the total tonnage passing through dealers' yards consisted of bituminous coal, 33.8 per cent was anthracite, and only 3.2 per cent was coke. The proportion of coke in the total varied widely in different parts of the country. It was highest in the Upper Mississippi Valley, particularly in the Lake States. Figure 51 shows that in only three States does coke form more than 5 per cent of the total tonnage handled by retail dealers.

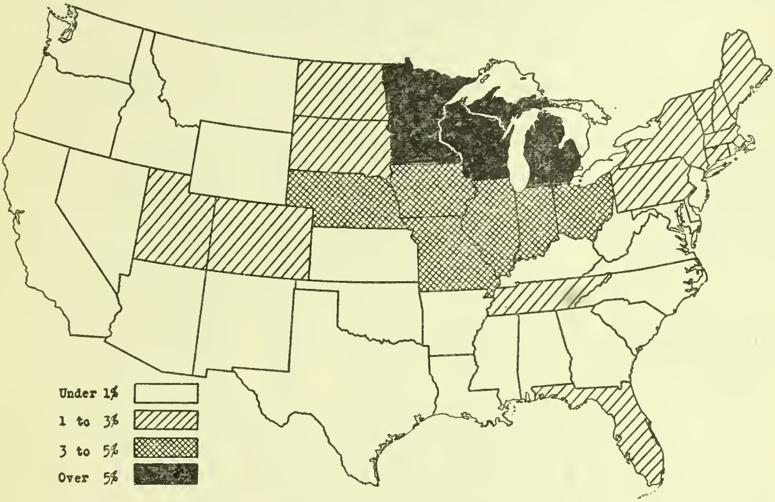

Figure 51.—Per cent of the total deliveries made by retail coal dealers that consisted of coke, 1928 and 1929. In only three States does coke form as much as 5 per cent of the total tonnage handled by retailers

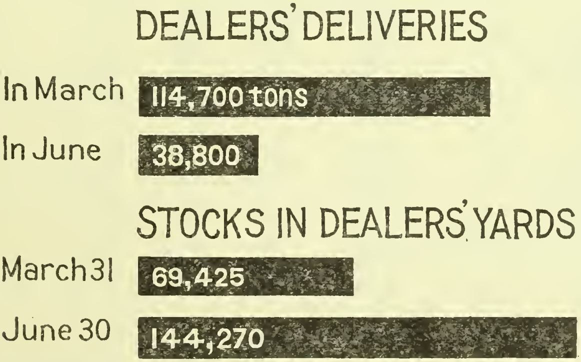

Figure 52.—How retail dealers assist in carrying the seasonal storage of coke. The chart summarizes the experience of 429 retailers handling coke in March and June, 1929

The potential service of the retailer in storing the coke during the summer months is indicated in Figure 52, which covers the experience of 429 retailers handling coke in March and June, 1929. These typical dealers reported that deliveries of coke to their consumers during June were barely a third of those in March. Stocks in their yards, on the other hand, developed from March 31 to June 30.

TABLE 45.—*Relative proportions of coke, anthracite, and bituminous coal in the deliveries made by 881 representative dealers*

[The figures cover a selected list of retailers who handle about 20 per cent of the total retail trade. They cover four periods of two months each, namely, August-September, 1928, November-December, 1928, February-March, 1929, and May-June, 1929. Figures for coke include retort coke and possibly some beehive oven coke]

	Total of four stock surveys (net tons delivered to consumers)				Per cent of total		
	Bituminous	Anthracite	Coke	Total	Bituminous	Anthracite	Coke
1. New England	2,286,909	1,722,429	46,840	4,056,178	56.4	42.5	1.1
Maine	187,842	108,290	5,007	301,139	62.4	36.0	1.6
New Hampshire	122,472	44,368	2,670	169,510	72.3	26.2	1.5
Vermont	22,479	50,095	1,317	73,891	30.4	67.8	1.8
Rhode Island	508,416	144,650	4,197	657,263	77.3	22.0	.7
Connecticut	205,984	313,984	8,581	528,549	39.0	59.4	1.6
Massachusetts	1,239,716	1,061,042	25,068	2,325,826	53.3	45.6	1.1
2. Middle Atlantic	1,288,292	4,022,115	116,710	5,427,117	23.7	74.1	2.2
New York	424,338	2,919,722	93,913	3,437,973	12.3	84.9	2.8
New Jersey	47,703	314,379	3,161	365,243	13.1	86.1	.8
Pennsylvania	435,028	472,626	17,207	924,861	47.0	51.1	1.9
Delaware	21,335	38,528	154	60,017	35.5	64.2	.3
Maryland	105,457	86,978	1,157	193,592	54.5	44.9	.6
District of Columbia	254,431	189,882	1,118	445,431	57.1	42.6	.3
3. Ohio	797,258	33,608	26,401	857,267	93.0	3.9	3.1
4. Southern Michigan	587,206	85,294	99,364	771,864	76.1	11.1	12.8
Illinois and Indiana	3,221,154	256,749	143,477	3,621,380	88.9	7.1	4.0
Illinois	2,741,462	249,026	120,351	3,110,839	88.1	8.0	3.9
Indiana	479,692	7,723	23,126	510,541	94.0	1.5	4.5
6. Lower Missouri Valley	974,665	24,559	32,864	1,032,088	94.4	2.4	3.2
Missouri	498,605	13,055	16,863	528,523	94.3	2.5	3.2
Iowa	382,775	8,473	13,235	404,483	94.6	2.1	3.3
Nebraska	75,412	1,689	2,685	79,786	94.5	2.1	3.4
Kansas	17,873	1,342	81	19,296	92.6	7.0	.4
7. Lake dock territory	709,954	129,513	102,942	942,409	75.3	13.8	10.9
Wisconsin	339,189	69,715	59,720	468,624	72.4	14.9	12.7
Northern Michigan	53,107	6,844	3,596	63,547	83.6	10.8	5.6
Minnesota	258,162	49,104	38,763	346,029	74.6	14.2	11.2
North Dakota	23,478	1,270	531	25,279	92.9	5.0	2.1
South Dakota	36,018	2,580	332	38,930	92.5	6.6	.9
8. Southeast	1,227,049	25,626	8,154	1,260,829	97.3	2.0	.7
West Virginia	40,857	805	24	41,686	98.0	1.9	.1
Virginia	124,243	19,000	777	144,020	86.3	13.2	.5
North Carolina	71,660	1,906	568	74,134	96.7	2.6	.7
South Carolina	48,520	576	221	49,317	98.4	1.2	.4
Georgia	200,970	1	164	201,135	99.9	--------	.1
Florida	12,183	1,505	528	14,216	85.7	10.6	3.7
Kentucky	357,246	564	614	358,424	99.7	.1	.2
Tennessee	267,673	1	4,585	272,259	98.3	--------	1.7
Alabama	72,721	1,240	648	74,609	97.5	1.7	.8
Mississippi	30,976	28	25	31,029	99.8	.1	.1
9. Southwest, Mountain, and Pacific	687,253	18,992	8,132	714,377	96.2	2.7	1.1
Louisiana	149,765	933	1,454	152,152	98.4	.6	1.0
Arkansas	4,085	606	7	4,698	87.0	12.9	.1
Oklahoma	6,539	33	35	6,607	99.0	.5	.5
Texas	4,624	462	10	5,096	90.7	9.1	.2
New Mexico	51,090	10,445	124	61,659	82.9	16.9	.2
Arizona	6,829	371	--------	7,200	94.8	5.2	--------
Colorado	184,290	3,990	3,604	191,884	96.0	2.1	1.9
Utah	50,659	--------	2,240	52,899	95.8	--------	4.2
Nevada	3,125	--------	--------	3,125	100.0	--------	--------
Wyoming	4,770	--------	--------	4,770	100.0	--------	--------
Montana	42,548	--------	--------	42,548	100.0	--------	--------
Idaho	57,128	--------	--------	57,128	100.0	--------	--------
Washington	38,177	30	--------	38,207	99.9	.1	--------
Oregon	38,019	--------	254	38,273	99.3	--------	.7
California	45,605	2,122	404	48,131	94.8	4.4	.8
Total United States	11,779,740	6,318,885	584,884	18,683,509	63.0	33.8	3.2

STOCKS OF COKE

With the growth of the domestic trade, the problem of storing the coke at the producers' plants becomes increasingly important, especially during the spring and summer. Table 46 gives details of the total quantity of coke and breeze on hand at all coke plants on January 1, 1929. On that date the by-product plants reported a total of 774,167 tons of furnace coke and 1,018,782 tons of domestic coke. Table 47 gives comparative figures of the total on hand as far back as the record is available. The stocks of coke on hand at producers' plants, by months during 1928, are given in Table 48. (See also fig. 53.) As might be expected it is shown that the furnace plants carry relatively steady stocks and that the stocks of merchant plants fluctuate sharply with the season. In comparing present stocks with those in the past it must be remembered that stocks tend to increase with the natural growth of the industry. Each new by-product plant adds its quota to the quantity of coke on hand. This element of growth is illustrated in Table 49, which shows the stocks at a group of 21 identical plants that have reported at intervals since January 1, 1922.

Table 46.—*Stocks of furnace and foundry coke, of domestic coke, and of breeze on January 1, 1929, by States, in net tons*

[Based on complete reports from all producers, including the 21 plants covered in Table 49]

State	Furnace and foundry	Domestic and other	Breeze
By-product plants:			
Alabama	424,541	50,605	63,024
Colorado	1,962	1,057	4,491
Illinois	116,774	174,058	94,923
Indiana	13,791	63,021	49,433
Maryland	10,272		14,162
Massachusetts		66,255	5,905
Michigan	5,045	39,007	48,641
Minnesota	(1)	[1]112,509	6,442
New Jersey		137,380	5,043
New York	38,525	154,581	24,186
Ohio	32,599	43,310	71,729
Pennslyvania	69,254	1,171	14,200
Tennessee	40,694	1,865	4,856
Utah	4,170	11,795	25,277
Washington	6,702		
West Virginia	8,542	8,079	13,617
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	1,296	154,089	12,930
	[1]774,167	[1]1,018,782	458,859
Beehive plants:			
Colorado	2,506		
Pennsylvania	36,685	8,511	66,326
Tennessee	344		
Utah	127		
Virginia	3,511		50
West Virginia	3,113		
Georgia, Kentucky, and Ohio	180		
	46,466	8,511	66,376

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[1] A small amount of furnace and foundry coke is included with domestic and other.

TABLE 47.—*Summary of total stocks of coke on hand at all by-product and beehive plants at the first of the year, 1923–1929*

	Jan. 1, 1923	Jan. 1, 1924	Jan. 1, 1925	Jan. 1, 1926	Jan. 1, 1927	Jan. 1, 1928	Jan. 1, 1929
By-product plants:							
Furnace	706, 598	748, 375	555, 080	367, 691	532, 831	627, 869	750, 318
Foundry	22, 542	76, 077	50, 794	22, 953	37, 414	29, 371	24, 426
Domestic and other	(1)	(1)	880, 386	263, 923	697, 135	1, 156, 991	1, 018, 205
Total	(1)	(1)	1, 486, 260	654, 567	1, 267, 380	1, 814, 231	1, 792, 949
Beehive plants:							
Furnace	88, 943	81, 346	59, 017	37, 435	25, 425	54, 441	38, 446
Foundry	3, 598	7, 620	12, 507	6, 938	6, 890	13, 615	8, 020
Domestic and other	(1)	(1)	2, 897	7, 180	6, 446	4, 147	8, 511
Total	(1)	(1)	74, 421	51, 553	38, 761	72, 203	54, 977
Total:							
Furnace	795, 541	829, 721	614, 097	405, 126	558, 256	682, 310	788, 764
Foundry	26, 140	83, 697	63, 301	29, 891	44, 304	42, 986	32, 446
Domestic and other	(1)	(1)	883, 283	271, 103	703, 581	1, 161, 138	1, 026, 716
Total	(1)	(1)	1, 560, 681	706, 120	1, 306, 141	1, 886, 434	1, 847, 926

[1] Data not available.

TABLE 48.—*Total stocks of coke on hand at all furnace and all nonfurnace by-product plants on the first of each month, 1928*

[Includes furnace, foundry, and domestic, but not breeze]

Date	Furnace plants	Other plants	Total
Jan. 1	646, 975	1, 167, 256	1, 814, 231
Feb. 1	689, 595	1, 106, 394	1, 795, 989
Mar. 1	713, 497	1, 002, 894	1, 716, 391
Apr. 1	748, 460	955, 121	1, 703, 581
May 1	769, 815	939, 152	1, 708, 967
June 1	750, 479	1, 001, 063	1, 751, 542
July 1	758, 260	1, 094, 849	1, 853, 109
Aug. 1	761, 850	1, 175, 041	1, 936, 891
Sept. 1	746, 225	1, 246, 876	1, 993, 101
Oct. 1	729, 749	1, 177, 119	1, 906, 868
Nov. 1	732, 308	1, 062, 752	1, 795, 060
Dec. 1	732, 690	1, 058, 970	1, 791, 660
Average for year	731, 658	1, 082, 291	1, 813, 949

TABLE 49.—*Total stocks of coke at 21 identical by-product coke plants supplying gas for city use, 1922–1928, in net tons*

1922	
Jan. 1	1, 017, 000
Mar. 1	987, 000
Oct. 1	250, 000
Nov. 1	228, 000
1923	
Jan. 1	212, 000
Feb. 1	146, 000
Mar. 1	92, 000
June 1	202, 000
July 1	308, 000
Aug. 1	430, 000
Sept. 1	501, 000
Oct. 1	476, 000
1924	
Jan. 1	772, 000
Sept. 1	1, 114, 000
1925	
Mar. 1	631, 000
June 1	722, 000
Sept. 1	865, 000
Nov. 1	623, 000
1926	
Jan. 1	248, 000
Feb. 1	90, 000
1926	
Apr. 1	53, 000
May 1	151, 000
July 1	334, 000
Aug. 1	470, 000
Oct. 1	628, 000
Nov. 1	579, 000
1927	
Jan. 1	516, 000
Feb. 1	353, 000
Apr. 1	470, 000
May 1	560, 000
July 1	584, 000
Aug. 1	705, 000
Oct. 1	799, 000
1928	
Jan. 1	787, 000
Feb. 1	749, 000
Apr. 1	750, 000
May 1	787, 000
July 1	879, 000
Aug. 1	952, 000
Oct. 1	959, 000
Nov. 1	806, 000
Dec. 31	883, 000

CONSUMPTION OF COKE

Allowing for imports and exports and for changes in producers' stocks the indicated consumption of coke in 1928 was 51,894,371 tons. (See Table 50.) Of this about 39,695,000 tons was consumed by blast furnaces in the manufacture of pig iron and ferro-alloys. The remainder was used in foundries, in smelting the nonferrous metals, in the manufacture of water gas, in miscellaneous other industrial uses, and for domestic heating. In 1928 the quantity consumed for these purposes was 12,199,371 tons, or 23.5 per cent of the total, as against 8,221,060 tons, or 18.1 per cent, in 1913.

The trend of fuel utilization in blast-furnace operation during recent years is shown in Table 51 and Figure 54. The quantity of coking coal required to make a gross ton of pig iron declined from an average of 3,637.2 pounds in 1913 to 3,053.4 pounds in 1928. In part the decline is due to the increasing burden of scrap, but in part it represents improvements in fuel efficiency in the blast furnace and improvements in the yield and quality of coke.

TABLE 50.—*Quantity of coke consumed in the manufacture of pig iron and for other purposes, 1913–1928, in net tons*

Year	Total production of coke	Imports	Exports	Net changes in stocks	Indicated United States consumption[1]	Consumed by iron furnaces[2]		Remainder consumed in other ways	
						Quantity	Per cent	Quantity	Per cent
1913	46,299,530	101,212	987,395	(3)	45,413,347	37,192,287	81.9	8,221,060	18.1
1914	34,555,914	133,226	663,585	(3)	34,025,555	27,070,856	79.6	6,954,699	20.4
1915	41,581,150	53,222	895,509	(3)	40,738,863	33,224,328	81.6	7,514,535	18.4
1916	54,533,585	54,955	1,174,645	(3)	53,413,895	44,431,905	83.2	8,981,990	16.8
1917	55,606,828	24,872	1,409,320	(3)	54,222,380	44,493,316	82.1	9,729,064	17.9
1918	56,478,372	30,168	1,687,824	(3)	54,820,716	45,703,594	83.4	9,117,122	16.6
1919	44,180,557	16,486	716,956	(3)	43,480,087	35,250,943	81.1	8,229,144	18.9
1920	51,345,043	41,143	919,802	(3)	50,466,384	41,976,171	83.2	8,490,213	16.8
1921	25,287,622	30,990	306,755	(3)	25,011,857	18,162,147	72.6	6,849,710	27.4
1922	37,124,012	94,228	511,541	−805,000	37,511,699	29,213,893	77.9	8,297,806	22.1
1923	56,977,534	85,002	1,237,342	+651,737	55,173,457	44,761,526	81.1	10,411,931	18.9
1924	44,269,605	82,833	659,350	−258,020	43,951,108	34,303,060	78.0	9,648,048	22.0
1925	51,266,943	201,579	953,812	−854,561	51,369,271	39,241,812	76.4	12,127,459	23.6
1926	56,865,537	284,548	987,260	+600,021	55,562,804	[4]40,600,000	73.1	14,962,804	26.9
1927	51,092,143	168,859	806,664	+580,293	49,874,045	[4]38,200,000	76.6	11,674,045	23.4
1928	52,805,828	147,701	1,097,666	−38,508	51,894,371	[4]39,695,000	76.5	12,199,371	23.5

[1] Production plus imports minus exports, plus or minus the decrease or increase, respectively, of the net changes in stocks.

[2] From Annual Statistical Report of American Iron and Steel Institute.

[3] Data not available.

[4] Includes an estimate for coke consumed in the manufacture of ferro-alloys which was not reported by the institute.

TABLE 51.—*Pounds of coke and of coking coal consumed per gross ton of pig iron made in the United States, 1913–1928*

Year	Pounds of coke per gross ton of pig iron and ferro-alloys[1]	Per cent yield of coke from coal	Calculated pounds coking coal per gross ton of pig iron and ferro-alloys	Year	Pounds of coke per gross ton of pig iron and ferro-alloys[1]	Per cent yield of coke from coal	Calculated pounds coking coal per gross ton of pig iron and ferro-alloys
1913	2,433.3	66.9	3,637.2	1921	2,200.6	68.0	3,236.2
1914	2,354.4	66.9	3,519.3	1922	2,176.3	68.3	3,186.4
1915	2,252.0	67.2	3,351.2	1923	2,243.3	67.5	3,323 4
1916	2,285.3	66.8	3,421.1	1924	2,212.0	68.1	3,248 2
1917	2,339.7	66.4	3,523.6	1925	2,150.4	68.8	3,125.6
1918	2,375.2	66.4	3,577.1	1926	2,091.2	68.6	3,048.4
1919	2,310.2	67.4	3,427.6	1927	2,122.3	68.6	3,093.7
1920	2,305.6	67.4	3,420.8	1928	2,088.5	68.4	3,053.4

[1] From Annual Statistical Report of American Iron and Steel Institute, 1928, p. 17.

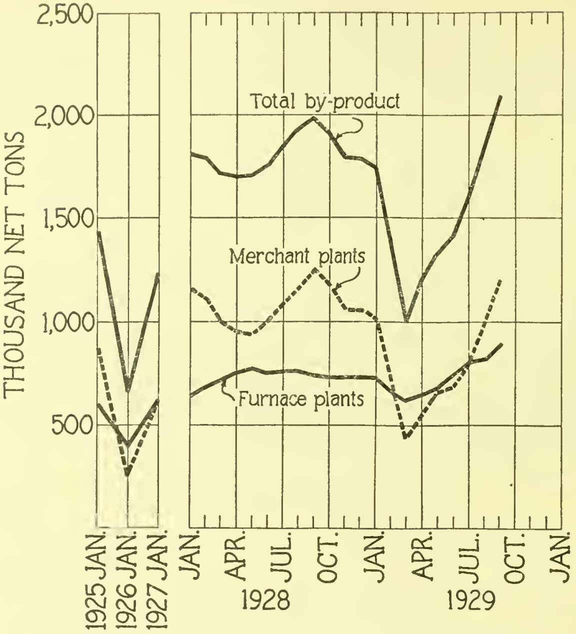

FIGURE 53.—Total stocks of by-product coke at producers' plants on the first of each month. Figures for merchant plants include by-product ovens operated by city gas companies

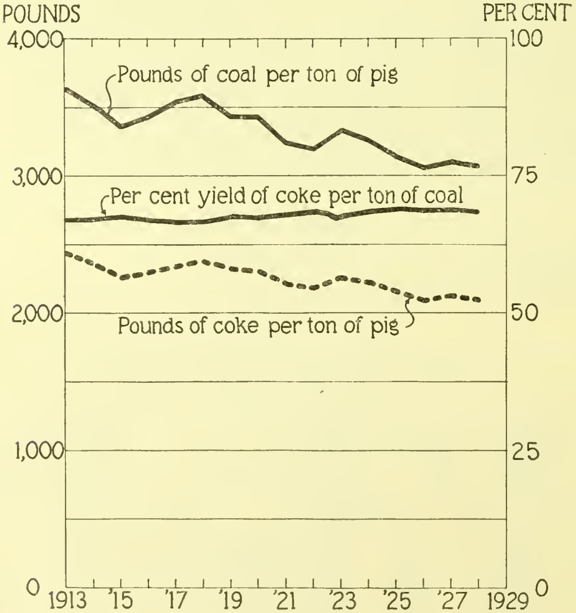

FIGURE 54.—The declining consumption of blast-furnace coke per gross ton of pig iron, 1913–1928. The quantity of coke consumed per ton of pig iron has been declining. At the same time the yield of coke per ton of coal carbonized has increased slightly, so that the consumption of coking coal per ton of pig iron produced has declined from 3,637 pounds in 1913 to 3,053 in 1928

VALUE AND PRICE

TABLE 52.—*Average receipts per net ton for coke sold, by States, in 1928*

State	By-product				Beehive			
	Furnace	Foundry	Other industrial, etc.	Domestic	Furnace	Foundry	Other industrial, etc.	Domestic
Alabama	(1)	$4.51	(1)	$3.32				
Illinois	$5.70	(1)	(1)	6.55				
Indiana		7.56	$6.26	4.90				
Michigan	(1)	8.51	(1)	6.13				
New York	5.83	(1)	(1)	7.13				
Ohio	4.82	6.67	4.32	3.81				
Pennsylvania	4.09	(1)	(1)	4.56	$3.27	$4.41	$3.05	$3.42
Tennessee	4.50	5.00		7.11	3.88	(2)		
Virginia					(2)	4.36	4.30	(1)
Washington				7.00			8.10	
West Virginia	(1)	(1)	(1)	(2)	3.35	4.10	2.89	4.69
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	4.82	7.75	7.42	6.63				
Other States[3]	(1)	8.32	7.17	8.53	6.98	7.73	7.72	(1)
Undistributed	6.08	7.57	6.13					6.70
	4.99	6.98	6.58	6.23	3.43	4.38	3.85	3.78

[1] Included under "Undistributed."
[2] Not at liberty to publish.
[3] Colorado, Georgia, Maryland, Massachusetts, Minnesota, New Jersey, and Utah.

TABLE 53.—*Average value per ton of all coke produced, 1913–1928, and average receipts per ton for coke sold, 1918–1928*

Year	Value per ton produced[1]			Receipts per ton sold		
	By-product	Beehive	Total	By-product	Beehive	Total
1913	$3.83	$2.39	$2.78	(2)	(2)	(2)
1914	3.39	2.15	2.56	(2)	(2)	(2)
1915	3.45	2.07	2.54	(2)	(2)	(2)
1916	3.95	2.69	3.13	(2)	(2)	(2)
1917	6.18	4.81	5.36	(2)	(2)	(2)
1918	7.42	6.21	6.77	$7.88	$6.08	$6.52
1919	6.37	5.15	5.85	6.58	5.05	5.60
1920	10.15	7.94	9.27	10.77	7.43	8.50
1921	5.95	5.45	5.84	7.72	5.41	6.56
1922	6.59	5.84	6.42	8.45	5.79	7.20
1923	6.85	5.98	6.56	8.53	6.06	6.98
1924	5.76	4.70	5.51	6.90	4.63	5.84
1925	5.28	4.56	5.12	6.61	4.52	5.70
1926	5.65	4.57	5.41	6.95	4.57	5.84
1927	5.29	4.20	5.13	6.57	4.15	5.76
1928	4.90	3.63	4.79	5.95	3.66	5.44

[1] Includes operators' statements of the value of coke consumed by them in associated enterprises but not sold, except that in 1918 and 1920 the value of such coke was estimated for each State at the average value for that State of the part of the product reported sold.
[2] Data not available.

TABLE 54.—*Average value per net ton of coke exported from the United States, 1900–1928*

[Computed from records of Bureau of Foreign and Domestic Commerce]

Year	Average value	Year	Average value	Year	Average value
1900	$3.22	1910	$3.10	1920	$10.87
1901	3.63	1911	3.14	1921	9.00
1902	4.06	1912	3.29	1922	8.44
1903	4.49	1913	3.35	1923	9.61
1904	3.94	1914	3.37	1924	7.47
1905	3.34	1915	3.45	1925	7.20
1906	3.21	1916	3.58	1926	7.07
1907	3.27	1917	6.06	1927	6.73
1908	3.11	1918	7.03	1928	6.74
1909	3.22	1919	7.15		

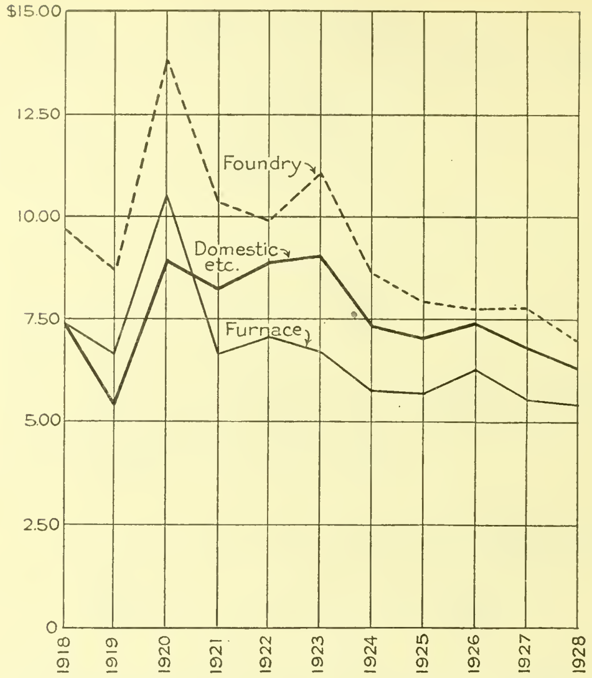

FIGURE 55.—The downward trend of coke prices. Average sales realization on sales of by-product coke for furnace, foundry, and domestic and miscellaneous industrial uses, 1918–1928

TABLE 55.—*Average monthly prices per net ton at ovens of spot or prompt Connellsville furnace and foundry coke, 1919–1928* [1]

Month	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928
FURNACE										
January	$5.65	$6.00	$5.06	$2.75	$8.05	$3.94	$3.94	$7.19	$3.50	$2.70
February	4.44	6.00	4.50	3.04	7.13	4.08	3.63	7.31	3.38	2.68
March	4.06	6.00	4.35	3.25	7.25	4.08	3.35	3.05	3.35	2.60
April	3.65	9.60	3.50	4.48	6.31	3.75	3.04	3.00	3.20	2.60
May	3.69	12.00	3.25	6.00	5.15	3.25	3.00	2.91	2.94	2.60
June	4.00	15.00	3.00	6.75	4.75	3.19	2.77	2.83	2.93	2.60
July	4.07	17.20	2.81	10.75	4.55	3.00	2.83	2.84	3.00	2.63
August	4.31	17.75	2.75	12.80	4.56	3.00	3.06	2.95	3.00	2.75
September	4.56	16.70	3.15	11.13	4.50	3.00	3.49	3.38	2.85	2.75
October	4.52	15.12	3.28	9.60	3.85	3.00	6.13	3.63	2.85	2.83
November	5.87	8.26	3.03	7.19	3.81	3.04	5.75	4.43	2.77	2.75
December	6.12	6.20	2.75	7.00	4.00	3.68	4.32	3.50	2.75	2.75
Average	4.58	11.32	3.45	7.06	5.33	3.42	3.78	3.92	3.04	2.69
FOUNDRY										
January	6.25	7.00	6.38	3.75	8.70	4.75	4.88	7.75	4.50	3.75
February	5.00	7.00	5.63	4.00	8.25	4.88	4.31	8.31	4.31	3.75
March	4.94	7.00	5.45	4.25	8.38	4.88	4.15	4.40	4.40	3.75
April	4.30	10.20	4.75	5.06	7.56	4.75	4.00	4.06	4.06	3.75
May	4.31	13.00	4.50	6.30	6.15	4.69	4.00	4.00	4.00	3.75
June	4.56	15.75	4.45	7.25	5.56	4.38	3.80	4.00	4.00	3.75
July	5.00	17.80	4.06	11.00	5.35	4.10	3.75	4.00	4.00	3.75
August	5.25	18.88	3.75	13.90	5.38	4.00	3.88	4.00	4.00	3.75
September	5.80	17.70	4.15	12.50	5.50	4.00	4.25	4.38	4.00	3.75
October	6.25	16.38	4.38	11.70	4.80	4.00	6.31	4.63	4.00	3.75
November	7.00	9.50	4.19	8.38	4.81	4.06	6.81	5.50	3.85	3.75
December	7.00	7.00	3.81	7.88	4.81	4.55	5.20	4.50	3.75	3.75
Average	5.47	12.27	4.63	8.00	6.27	4.42	4.61	4.96	4.11	3.75

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[1] Iron Age, Jan. 3, 1929, p. 128.

TABLE 56.—*Average monthly prices of by-product foundry coke, in 10 markets, as quoted by Iron Trade Review*

	January	February	March	April	May	June	July	August	September	October	November	December	Average for year
Ashland, Ky. (at ovens):													
1926	(1)	(1)	(1)	(1)	(1)	$8.00	$7.50	$7.50	$7.50	$7.50	$7.50	$8.00	(1)
1927	$8.00	$8.00	$7.50	$7.50	$7.50	7.50	7.50	7.50	7.50	7.50	7.50	7.50	$7.58
1928	7.50	7.50	7.50	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.13
Birmingham, Ala. (at ovens):													
1925	(1)	4.90	5.00	5.00	4.65	4.50	4.50	4.50	4.60	4.75	5.70	5.70	(1)
1926	5.60	5.50	5.50	5.15	5.15	5.50	5.50	5.50	5.50	5.50	5.50	5.50	5.45
1927	5.15	5.50	5.50	5.50	5.50	5.50	5.50	5.50	5.50	5.50	5.25	5.00	5.41
1928	5.00	5.00	5.00	3.95	4.80	5.00	5.00	5.00	5.00	5.00	5.00	5.00	4.90
Buffalo, N. Y. (at ovens):													
1927	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	9.00	9.00	9.00	9.00	(1)
1928	9.00	9.00	8.65	8.50	8.50	9.00	9.00	9.00	9.00	9.00	9.00	9.00	8.89
Chicago, Ill. (at ovens):													
1921	(1)	(1)	(1)	(1)	(1)	(1)	11.25	11.25	11.25	11.25	11.25	11.25	(1)
1922	11.25	11.25	11.25	11.25	11.25	11.25	11.25	12.60	13.50	13.50	14.70	15.00	12.34
1923	15.00	15.00	15.00	15.00	15.00	15.00	13.50	13.50	13.50	13.50	12.50	12.50	14.08
1924	12.50	12.50	12.50	12.50	12.50	12.50	11.45	10.75	10.75	10.75	10.75	10.75	11.68
1925	10.75	10.75	10.75	10.75	10.75	10.75	9.75	9.75	9.75	10.25	10.45	10.50	10.41
1926	10.50	10.50	10.50	9.95	9.75	9.75	9.75	9.75	9.75	9.75	9.75	10.25	10.00
1927	9.75	9.75	9.75	9.75	9.75	9.75	9.75	9.75	9.75	9.75	9.30	9.00	9.65
1928	9.00	9.00	9.00	9.00	9.00	8.50	8.00	8.00	8.00	8.00	8.00	8.00	8.46
Detroit, Mich. (at ovens):													
1927	(1)	(1)	(1)	(1)	(1)	(1)	(1)	9.15	9.00	9.00	9.00	9.00	(1)
1928	9.00	9.00	9.00	9.00	9.00	8.90	8.50	8.50	8.50	8.50	8.50	8.50	8.74
Indianapolis, Ind. (delivered at consumers' works):													
1925	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	11.25	(1)
1926	11.25	11.25	11.25	10.75	10.75	10.75	10.25	10.25	10.25	10.25	10.25	10.25	10.63
1927	10.25	10.25	10.25	10.25	10.25	10.25	10.25	10.25	9.75	9.75	9.75	9.75	10.08
1928	9.75	9.75	9.75	8.75	8.75	8.75	8.50	8.25	8.25	8.25	8.25	8.25	8.77
Newark, N. J. (delivered at consumers' works):													
1921	(1)	(1)	(1)	(1)	(1)	(1)	8.84	8.84	8.84	8.84	8.84	8.84	(1)
1922	8.59	8.59	8.59	8.84	9.49	10.34	11.47	14.04	14.84	14.84	13.28	12.84	11.31
1923	12.84	12.84	12.84	12.84	12.34	11.84	11.34	11.34	11.34	11.41	10.91	10.91	11.90
1924	10.91	10.91	10.91	10.81	10.41	10.41	10.41	10.41	10.41	10.41	10.41	10.41	10.57
1925	10.41	10.41	10.41	10.41	10.41	10.41	10.41	10.41	10.41	10.71	11.04	11.52	10.58
1926	11.01	11.01	11.01	9.59	9.59	9.59	9.59	9.59	9.59	9.59	10.59	10.59	10.11
1927	9.84	9.59	9.59	9.59	9.59	9.59	9.59	9.59	9.59	9.59	9.59	9.59	9.61
1928	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00
New England[2] (delivered at consumers' works):													
1921	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	10.66	10.66	10.66	10.66	(1)
1922	10.40	10.25	10.15	10.15	10.15	10.15	14.00	16.30	16.50	16.50	16.20	16.00	13.06
1923	16.00	16.00	16.00	16.00	16.00	15.50	13.50	13.50	13.50	13.50	12.50	12.50	14.54
1924	12.50	12.50	12.50	12.00	12.00	11.30	11.80	11.50	11.50	11.50	11.50	11.50	11.84
1925	11.50	12.00	12.00	12.00	12.00	11.50	11.50	11.65	12.00	12.00	12.90	13.00	12.00
1926	13.00	13.00	13.00	12.50	12.50	12.00	12.00	12.00	12.00	12.00	13.00	13.50	12.54
1927	13.50	12.65	12.50	12.50	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.26
1928	11.50	11.50	11.50	11.00	11.00	11.00	11.00	11.00	11.00	11.00	11.00	11.00	11.13
Portsmouth, Ohio (at ovens):													
1926	(1)	(1)	(1)	(1)	(1)	7.50	7.50	7.50	7.50	7.40	7.90	8.00	(1)
1927	8.00	7.50	7.50	7.50	7.50	7.50	7.50	7.50	7.50	7.50	7.50	7.50	7.54
1928	7.50	7.50	7.50	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.13
St. Louis, Mo. (at ovens):													
1921	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	9.50	(1)
1922	9.50	9.50	9.30	9.00	9.00	9.00	9.00	11.40	13.00	14.00	14.00	14.00	10.89
1923	14.00	14.25	14.20	14.00	14.00	14.00	14.00	13.00	13.00	13.00	13.00	13.00	13.62
1924	12.50	12.50	12.50	12.00	12.00	10.60	9.20	9.00	9.00	9.00	9.00	9.00	10.53
1925	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.15	9.50	9.80	10.00	10.00	9.29
1926	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.25	10.50	10.06
1927	10.50	10.50	10.50	9.75	9.75	9.75	9.75	9.75	9.75	9.75	9.75	9.75	9.94
1928	9.75	9.75	9.75	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.19

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[1] No data.

[2] Before July, 1924, reported as "Boston, Mass., delivered at consumers' works."

SHIPMENTS BY RAIL AND WATER

Tables 57 to 59, which follow, show the quantity of by-product and beehive coke shipped by originating railroads and waterways. They are compiled from reports of the coke operators and therefore may not always agree with the records of the carriers themselves. In the by-product industry a large part of the coke produced is consumed close to the ovens and is not loaded for shipment. In 1928 shipments of by-product coke amounted to only 47.4 per cent of production. (See Table 57.) The beehive ovens, on the other hand, are usually situated at the mines, and the great bulk of the beehive coke produced must be transported some distance to reach the place of use. Table 58 indicates that in 1928, for the country as a whole, 95.2 per cent of the beehive coke produced was loaded for shipment.

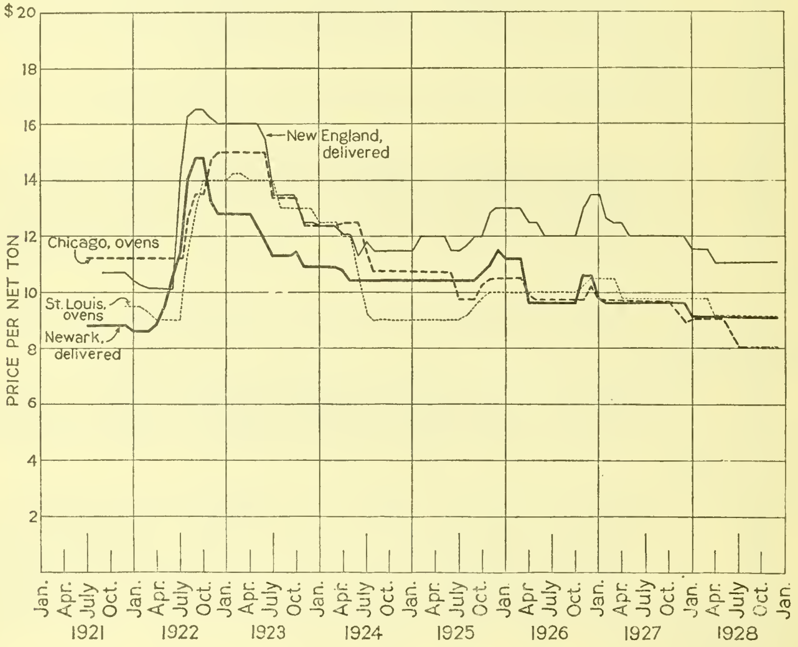

FIGURE 56.—Average monthly price of by-product foundry coke in four markets, 1921–1928, as quoted by Iron Trade Review

In some localities, however, the furnaces that consume beehive coke are also located at the mines, and considerable quantities of the coke produced are used locally without appearing as railroad shipments. This fact is notable in the Birmingham district.

Water-borne shipments of beehive coke are practically confined to the Monongahela River, down which a comparatively small tonnage is transported from the Connellsville field to the Pittsburgh district. By-product coke moves in small quantities over several water routes, the most important being the Detroit, Hackensack, Hudson, and Monongahela Rivers.

TABLE 57.—*By-product coke loaded for shipment on originating railroads and waterways in the United States in 1928, by States, as reported by the coke producers*

State	Originating railroad or waterway	Shipments (net tons)	Production (net tons)	Per cent of State production shipped
	RAILROADS			
Alabama	Birmingham Southern; Illinois Central; Louisville & Nashville; St. Louis-San Francisco; Seaboard Air Line; Southern.	1,875,051	4,327,324	43.3
Colorado	Colorado & Wyoming	10,369	605,822	1.7
Illinois	Alton & Eastern; Alton & Southern; Belt Railway of Chicago; Chicago & Illinois Western; Chicago & North Western; Chicago Short Line; Elgin, Joliet & Eastern; Illinois Central; Terminal Railroad Association.	953,469	3,240,964	29.4
Indiana	Cleveland, Cincinnati, Chicago & St. Paul; Chicago, Milwaukee, St. Paul & Pacific; Elgin, Joliet & Eastern; New York Central; Pennsylvania; Wabash.	2,125,151	6,094,201	34.9
Maryland	Baltimore & Ohio; Pennsylvania; Western Maryland.	1,900	1,186,398	.2
Massachusetts	Boston & Albany; Boston & Maine; New York, New Haven & Hartford.	575,200	687,356	83.7
Michigan	Canadian Pacific; Delray Connecting; Detroit Terminal; Detroit, Toledo, & Ironton; Grand Trunk Railway System; Michigan Central; New York Central; Pennsylvania; Pere Marquette.	1,350,541	2,399,656	56.3
Minnesota	Duluth, Missabe & Northern; Great Northern; Northern Pacific.	197,778	622,696	31.8
New Jersey	Delaware, Lackawanna & Western; Erie; Pennsylvania.	156,696	903,177	17.3
New York	Buffalo, Rochester & Pittsburgh; Delaware, Lackawanna & Western; Lehigh Valley; New York Central; New York, New Haven & Hartford; New York, Ontario & Western; South Buffalo.	1,780,152	3,802,657	46.8
Ohio	Baltimore & Ohio; Erie; Fairport, Painesville & Eastern; Lake Erie & Eastern; Lake Terminal; Newburgh & South Shore; New York Central; Nickel Plate; Norfolk & Western; Pennsylvania; Pittsburgh & Lake Erie; River Terminal; Toledo Terminal; Wheeling & Lake Erie.	2,838,506	7,786,199	36.5
Pennsylvania	Conemaugh & Black Lick; Lehigh Valley; Pennsylvania; Philadelphia & Reading; Union; Upper Merion & Plymouth.	6,988,615	13,475,349	51.9
Tennessee	Central of Georgia; Nashville, Chattanooga & St. Louis; Southern.	92,906	113,134	82.1
Utah	Denver & Rio Grande Western; Union Pacific.	129,000	246,503	52.3
Washington	Northern Pacific	300	40,755	.7
West Virginia	Baltimore & Ohio; Monongahela; Pennsylvania.	449,028	1,367,481	32.8
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin.	Chesapeake & Ohio; Chicago & North Western; Chicago, Milwaukee, St. Paul & Pacific; Minneapolis, St. Paul & Sault Ste. Marie; Missouri Pacific; New York, New Haven & Hartford.	1,182,897	1,413,353	83.7
	Total railroad shipments	20,707,559		
	WATERWAYS			
Maryland	Chesapeake Bay	86,368	(1)	7.3
Michigan	Detroit River	249,795	(1)	10.4
New Jersey	Delaware River; Hackensack River	483,577	(1)	53.5
New York	East River; Hudson River; Long Island Sound.	475,222	(1)	12.5
Connecticut, Massachusetts, and Rhode Island.	Boston Harbor; Connecticut River; Long Island Sound; Narragansett Bay.	47,750	(1)	5.3
Ohio, Pennsylvania, and Wisconsin.	Lake Erie; Lake Michigan; Monongahela River.	830,508	(1)	(2)
	Total waterway shipments	2,173,220		
	Grand total	22,880,779	48,313,025	47.4

[1] Figures given under respective States above.

[2] Not at liberty to publish.

TABLE 58.—*Beehive coke loaded for shipment on originating railroads and waterways in the United States in 1928, by States, as reported by the coke producers*

State	Originating railroad or waterway	Shipments (net tons)	Production (net tons)	Per cent of State production shipped
	RAILROADS			
Colorado	Colorado & Wyoming	38,521		
	Denver & Rio Grande Western	92,789		
		131,310	144,200	91.1
Ohio			(1)	
Pennsylvania	Baltimore & Ohio	216,632		
	Buffalo, Rochester & Pittsburgh	102,073		
	Ligonier Valley	77,448		
	Monongahela	1,169,344		
	Pennsylvania	1,379,357		
	Pittsburgh & Lake Erie	28,414		
	Washington Run	65,501		
		3,038,769	3,442,006	88.3
Tennessee	Nashville, Chattanooga & St. Louis	17,245		
	Southern	16,231		
		33,476	103,791	32.3
Utah	Denver & Rio Grande Western	28,097	28,097	100.0
Virginia	Interstate	192,726		
	Southern	350		
	Louisville & Nashville; Norfolk & Western	55,221		
		248,297	247,734	[2] 100.2
Washington	Northern Pacific	18,747	18,747	100.0
West Virginia	Baltimore & Ohio	88,557		
	Chesapeake & Ohio	117,852		
	New York Central	130,636		
	Norfolk & Western	92,553		
	Western Maryland	5,175		
		434,773	431,419	[2] 100.8
eorgia and Kentucky	Central of Georgia; Louisville & Nashville	42,077	[1] 76,809	54.8
	Total railroad shipments	3,975,546		
	WATERWAYS			
Pennsylvania	Monongahela River	302,782	(3)	8.8
	Grand total	4,278,328	4,492,803	95.2

[1] Ohio included with Georgia and Kentucky.
[2] Excess of shipments over production represents inclusion of screenings or withdrawal from stock.
[3] Figures given under Pennsylvania above.

TABLE 59.—*Beehive coke loaded for shipment on originating railroads and waterways in the United States in 1928, by routes, as reported by the coke producers*

Route	State	Quantity (net tons)		Per cent of total
		By States	Total	
Railroads:				
Baltimore & Ohio	Pennsylvania West Virginia	216,632 88,557	305,189	7.1
Buffalo, Rochester & Pittsburgh	Pennsylvania	102,073	102,073	2.4
Chesapeake & Ohio	West Virginia	117,852	117,852	2.8
Colorado & Wyoming	Colorado	38,521	38,521	.9
Denver & Rio Grande Western	do Utah	92,789 28,097	120,886	2.8
Interstate	Virginia	192,726	192,726	4.5
Ligonier Valley	Pennsylvania	77,448	77,448	1.8
Monongahela	do	1,169,344	1,169,344	27.3
Nashville, Chattanooga & St. Louis	Tennessee	17,245	17,245	.4
New York Central	West Virginia	130,636	130,636	3.1
Norfolk & Western	Virginia and West Virginia.	147,624	147,624	3.5
Northern Pacific	Washington	18,747	18,747	.4

TABLE 59.—*Beehive coke loaded for shipment on originating railroads and waterways in the United States in 1928, by routes, as reported by the coke producers*—Contd.

Route	State	Quantity (net tons)		Per cent of total
		By States	Total	
Railroads-Continued.				
Pennsylvania	Pennsylvania	1, 379, 357	1, 379, 357	32. 2
Pittsburgh & Lake Erie	do	28, 414	28, 414	. 7
Southern	Tennessee Virginia	16, 231 350	16, 581	. 4
Washington Run	Pennsylvania	65, 501	65, 501	1. 5
Western Maryland	West Virginia	5, 175	5, 175	. 1
Central of Georgia; Louisville & Nashville.	Georgia, Kentucky, and Virginia.	42, 227	42, 227	1. 0
Total railroad shipments		3, 975, 546	3, 975, 546	92. 9
Waterway: Monongahela River	Pennsylvania	302, 782	302, 782	7. 1
Grand total		4, 278, 328	4, 278, 328	100. 0

EXPORTS AND IMPORTS [3]

TABLE 60.—*Coke exported from the United States, 1909–1928*

Year	Net tons	Value	Year	Net tons	Value
1909	1, 002, 916	$3, 232, 673	1919	716, 956	$5, 128, 119
1910	984, 618	3, 053, 293	1920	919, 802	9, 993, 665
1911	1, 023, 727	3, 215, 990	1921	306, 755	2, 760, 939
1912	912, 576	3, 002, 742	1922	511, 541	4, 319, 538
1913	987, 395	3, 309, 930	1923	1, 237, 342	11, 889, 897
1914	663, 585	2, 233, 686	1924	659, 350	4, 926, 478
1915	895, 509	3, 092, 498	1925	953, 812	6, 871, 962
1916	1, 174, 645	4, 202, 236	1926	987, 260	6, 979, 896
1917	1, 409, 320	8, 543, 746	1927	806, 664	5, 430, 704
1918	1, 687, 824	11, 861, 408	1928	1, 097, 666	7, 394, 531

TABLE 61.—*Coke exported from the United States, 1926–1928, by customs districts*

District	1926		1927		1928	
	Net tons	Value	Net tons	Value	Net tons	Value
Arizona	837	$7, 862	1, 317	$10, 774	815	$6, 548
Buffalo	418, 251	3, 177, 383	320, 599	2, 099, 257	478, 075	3, 034, 232
Dakota	11, 378	91, 948	14, 801	116, 664	12, 627	97, 162
Duluth-Superior	4, 262	38, 509	2, 704	21, 235	3, 922	25, 391
El Paso	39	480	52	581	20	341
Florida	12, 393	127, 606	13, 540	148, 594	14, 239	86, 896
Galveston					8, 543	62, 850
Los Angeles	3	20	672	5, 934	83	833
Maine and New Hampshire	3, 628	28, 415	3, 543	26, 786	3, 569	27, 000
Maryland	15, 841	109, 542	6, 352	45, 266	5, 007	32, 481
Massachusetts			4	54	6, 523	44, 909
Michigan	360, 791	2, 406, 630	309, 534	1, 986, 981	447, 449	3, 120, 416
Mobile	6, 736	116, 388	7, 820	136, 179	12, 112	152, 845
New Orleans	1, 734	15, 470	1, 681	21, 194	5, 488	88, 193
New York	5, 796	62, 829	5, 884	66, 673	1, 329	17, 611
Ohio	97, 096	423, 189	73, 902	445, 927	69, 671	385, 149
Philadelphia	2, 009	13, 094	2, 801	25, 431	2, 064	10, 015
Porto Rico	40	570	67	834	31	467
Rochester	90	559	55	341		
Sabine	3, 306	27, 500				
St. Lawrence	16, 277	138, 377	14, 380	101, 619	10, 506	86, 662
San Antonio	582	4, 240	456	2, 652	576	3, 930
San Francisco	205	4, 136	68	1, 272	60	1, 118
South Carolina	245	2, 013				
Vermont	14, 726	114, 435	12, 928	99, 478	12, 105	88, 756
Virginia	9, 080	56, 967	4, 280	21, 118	2, 105	11, 794
Washington	1, 915	11, 734	9, 224	45, 860	747	8, 932
	987, 260	6, 979, 896	806, 664	5, 430, 704	1, 097, 666	7, 394, 531

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[3] Figures on exports and imports, unless otherwise indicated, compiled by J. A. Dorsey, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.

TABLE 62.—*Coke exported from the United States, 1926–1928, by countries of destination*

Destination	1926		1927		1928	
	Net tons	Value	Net tons	Value	Net tons	Value
Africa (British West)	3	$57	3	$68		
Argentina	840	9,221				
Australia					132	$1,239
Austria	560	10,000				
Barbados	6	85				
Bermudas					26	340
Bolivia					22	270
Brazil	1,867	20,457	39	623		
British Honduras			1	10		
Canada	932,645	6,459,748	764,096	4,960,696	1,044,484	6,913,605
Chile	13,157	83,209	7,896	54,103	4,445	29,127
Colombia	221	3,830	97	1,678	184	2,645
Costa Rica	36	628	66	1,408	59	774
Cuba	13,733	139,717	15,835	162,068	21,566	126,198
Dominican Republic	96	1,284	119	1,537	54	799
Ecuador	46	403	83	1,346	127	1,795
France	4,900	63,406	4,947	82,340	2,247	28,312
French Oceania			2	40	11	221
Germany	3,200	36,364	2,775	42,305	5,045	86,385
Greenland	32	250				
Guatemala	85	1,520	63	1,037	245	3,163
Haiti	28	420	44	343	30	228
Honduras	85	1,366	72	1,106	91	1,349
Italy	1,414	25,080	896	16,000	7,709	85,809
Mexico	1,805	16,650	3,174	28,077	2,019	17,540
Netherlands	3,413	38,091	1,148	20,000	4,379	52,057
Netherland West Indies	6	65	10	114		
Newfoundland and Labrador					58	472
Nicaragua	29	520	28	503	35	648
Norway	370	2,554	1,209	11,733	792	7,157
Other British West Indies	13	336	13	158	58	550
Panama	91	1,620	176	3,298	320	4,724
Paraguay	28	504				
Peru	142	2,543	1,868	11,262	2,691	14,450
Philippine Islands	148	2,882				
Portugal	259	1,552				
Salvador	57	1,222	38	655	59	1,074
Spain	30	525				
Trinidad and Tobago	10	154	6	60	11	137
United Kingdom	675	12,061	1,734	24,506	675	12,113
Uruguay	4,860	21,656				
Venezuela	2,368	19,889	225	3,618	92	1,350
Virgin Islands of the United States	2	27	1	12		
	987,260	6,979,896	806,664	5,430,704	1,097,666	7,394,531

TABLE 63.—*Coke exported from the United States, 1926–1928, by months*

Month	1926		1927		1928	
	Net tons	Value	Net tons	Value	Net tons	Value
January	91,687	$746,178	66,608	$488,437	72,411	$480,582
February	75,821	634,893	66,084	486,946	85,362	564,945
March	97,280	775,138	52,010	394,948	82,766	530,404
April	61,501	435,745	55,495	376,163	69,568	451,639
May	89,895	577,119	56,531	379,721	99,894	605,377
June	85,626	572,049	65,897	425,232	77,211	488,222
July	91,150	553,096	65,004	390,342	88,517	499,002
August	84,320	524,081	61,925	410,372	78,277	473,461
September	72,160	514,944	85,101	567,065	86,959	544,520
October	94,554	577,013	77,361	504,224	111,870	681,562
November	75,199	562,990	84,272	560,811	135,076	814,013
December	68,067	506,650	70,376	446,443	109,755	1,260,804
	987,260	6,979,896	806,664	5,430,704	1,097,666	7,394,531

TABLE 64.—*Coke imported for consumption in the United States, 1909–1928*

Year	Net tons	Value	Year	Net tons	Value
1909	191,253	$736,120	1919	16,486	$140,653
1910	172,716	625,130	1920	41,143	403,175
1911	77,923	254,455	1921	30,990	336,394
1912	123,614	488,398	1922	94,228	802,987
1913	101,212	435,157	1923	85,002	862,596
1914	133,226	551,104	1924	82,833	795,477
1915	53,222	222,382	1925	201,579	1,609,474
1916	54,955	249,514	1926	284,548	2,174,350
1917	24,872	146,451	1927	168,859	1,371,568
1918	30,168	221,880	1928	147,701	1,132,855

TABLE 65.—*Coke imported into the United States, 1926–1928, by customs districts*

District	1926		1927		1928	
	Net tons	Value	Net tons	Value	Net tons	Value
Buffalo	21,754	$472,228	22,658	$367,699	22,719	$450,391
Connecticut	4,814	22,145	----------	----------	3,201	19,474
Hawaii	----------	----------	562	2,535	672	4,160
Los Angeles	17,356	105,830	22,859	136,272	25,448	157,816
Maine and New Hampshire	19,615	118,578	386	2,865	1,730	11,652
Massachusetts	43,712	262,409	----------	----------	----------	----------
Michigan	10,316	73,831	50,225	427,819	10,670	65,562
Montana and Idaho	27,892	223,506	24,828	178,835	15,948	121,142
New York	62,844	494,391	36	645	8	84
Ohio	----------	----------	37	103	----------	----------
Oregon	4,085	22,574	4,395	22,853	3,734	16,539
Philadelphia	----------	----------	----------	----------	1,232	4,523
Porto Rico	----------	----------	10	140	----------	----------
Rhode Island	16,659	99,922	4,477	21,850	10,071	40,802
St. Lawrence	360	3,593	69	572	29	228
San Antonio	32	323	713	6,466	4,560	34,738
San Francisco	45,815	224,331	30,019	158,329	35,139	150,646
Vermont	502	4,208	512	4,323	440	3,085
Washington	8,792	46,481	7,073	40,262	12,100	52,013
	284,548	2,174,350	168,859	1,371,568	147,701	1,132,855

TABLE 66.—*Coke imported into the United States, 1926–1928, by countries*

Country	1926		1927		1928	
	Net tons	Value	Net tons	Value	Net tons	Value
Belgium	8,501	$35,593	840	$4,435	5,878	$24,875
Canada	62,177	785,173	99,267	985,868	51,152	648,832
Germany	60,104	315,603	41,079	213,100	10,951	51,441
Mexico	32	323	713	6,466	4,493	34,204
Netherlands	58,243	479,343	6,550	56,762	20,247	138,998
United Kingdom	95,491	558,315	20,400	104,797	54,980	234,505
West Indies (" Other British ")	----------	----------	10	140	----------	----------
	284,548	2,174,350	168,859	1,371,568	147,701	1,132,855

COKE IN CANADA

Most of the coke exported from the United States goes to Canada. The tonnage exported has tended to increase (Table 60), and the increase has gone largely for household heating. At the same time Canada has increased her own production of domestic coke through the construction of new by-product ovens. Tables 67 and 68 have been abstracted from the reports of the Dominion Bureau of Statistics, which should be consulted for details. The tables include gas-house coke.

TABLE 67.—*Coal consumed, coke produced, etc., in Canada, 1928, by months, in net tons*[1]

Month	Bituminous coal consumed	Coke produced	Disposition of coke by operators		
			Used in coke plant	Used in own smelters	Sold
January	256, 836	182, 032	21, 021	84, 364	89, 906
February	232, 687	169, 245	19, 041	90, 670	69, 691
March	251, 509	182, 394	20, 030	88, 634	78, 900
April	243, 431	174, 213	21, 040	95, 637	54, 057
May	265, 562	192, 645	24, 669	122, 691	31, 531
June	271, 094	194, 662	17, 104	118, 624	33, 112
July	279, 363	200, 016	18, 546	109, 809	40, 436
August	268, 989	191, 284	18, 748	99, 710	52, 256
September	269, 768	194, 059	20, 989	88, 963	67, 590
October	293, 878	210, 120	20, 797	98, 798	79, 735
November	283, 805	204, 568	20, 121	98, 210	83, 205
December	295, 736	212, 889	21, 980	100, 931	91, 589
	[2] 3, 212, 658	2, 308, 127	244, 086	1, 197, 041	772, 008

[1] Abstracted from Dominion Bureau of Statistics, 1928, Quarterly Report, vol. 7, No. 4.
[2] Of this total 2,309,075 tons was imported, chiefly from the United States.

TABLE 68.—*Production, imports, and consumption of coke in Canada, 1928, by months, in net tons*[1]

Month	Canadian production				Imports	Apparent consumption[2]
	Eastern Provinces	Ontario	Western Provinces	Total Canada		
January	51, 182	113, 790	17, 060	182, 032	71, 210	249, 440
February	45, 291	107, 218	16, 736	169, 245	70, 317	236, 290
March	51, 486	114, 807	16, 101	182, 394	95, 254	274, 504
April	48, 959	110, 047	15, 207	174, 213	45, 885	219, 160
May	50, 405	128, 333	13, 907	192, 645	95, 606	286, 608
June	52, 629	128, 090	13, 943	194, 662	69, 330	262, 508
July	60, 651	126, 786	12, 579	200, 016	82, 708	281, 117
August	59, 593	118, 223	13, 468	191, 284	82, 889	272, 570
September	64, 734	115, 607	13, 718	194, 059	82, 583	274, 666
October	72, 060	122, 540	15, 520	210, 120	132, 536	340, 358
November	68, 447	121, 378	14, 743	204, 568	127, 400	330, 684
December	69, 947	127, 539	15, 403	212, 889	103, 163	314, 045
	695, 384	1, 434, 358	178, 385	2, 308, 127	1, 058, 881	3, 341, 950

[1] Abstracted from Dominion Bureau of Statistics, 1928, Quarterly Report, vol. 7, No. 4.
[2] Allowing for exports which ordinarily are small.

WORLD PRODUCTION

TABLE 69.—*Coke produced in the principal countries of the world, 1924–1928, in metric tons* [1]

[Compiled under supervision of L. M. Jones, of the Bureau of Mines]

Country	1924	1925	1926	1927	1928
Australia:					
New South Wales	573, 420	619, 199	607, 255	720, 727	528, 550
Queensland	7, 230	5, 470	6, 2 0	4, 263	4, 124
Belgium	4, 308, 797	4, 236, 354	5, 076, 954	5, 879, 970	6, 322, 920
Bulgaria	----------	1, 193	1, 582	1, 448	898
Canada	833, 691	959, 438	1, 329, 314	1, 366, 623	[2] 1, 686, 895
China (exports)	27, 606	[3] 19, 217	14, 551	12, 989	14, 211
Chosen	105, 585	107, 574	119, 338	130, 356	(4)
Czechoslovakia	2, 220, 556	2, 015, 968	1, 961, 762	2, 428, 584	2, 821, 423
France	5, 414, 664	6, 016, 000	6, 908, 000	(4)	(4)
Germany [5]	25, 100, 888	28, 669, 631	27, 552, 668	33, 504, 883	35, 042, 358
Great Britain [6]	12, 958, 049	11, 185, 375	4, 790, 420	12, 027, 121	12, 035, 326
India, British [7]	371, 944	478, 753	554, 045	661, 506	(4)
Indo-China	----------	1, 153	2, 565	(4)	2, 500
Italy	309, 971	512, 264	591, 528	578, 445	641, 399
Japan:					
Japan proper—					
Manufactured coke	832, 429	849, 202	1, 035, 409	1, 086, 023	1, 237, 754
Natural coke	110, 327	89, 877	130, 381	143, 447	165, 883
Taiwan	(4)	13, 409	[8] 15, 602	(4)	(4)
Netherlands	975, 779	1, 143, 806	1, 198, 609	1, 478, 822	1, 573, 392
Peru	20, 000	18, 010	25, 960	13, 812	19, 331
Poland	949, 758	963, 964	1, 113, 380	1, 402, 008	1, 667, 906
Rhodesia, Southern	137, 078	138, 339	153, 069	146, 966	139, 719
Russia [9]	723, 800	1, 350, 300	2, 755, 841	3, 327, 904	(4)
Spain	724, 082	861, 130	693, 739	714, 243	680, 555
Sweden	79, 328	77, 369	112, 542	115, 756	104, 805
Union of South Africa	67, 561	67, 829	80, 312	98, 249	94, 089
United States	40, 160, 500	46, 508, 345	51, 587, 278	46, 349, 770	47, 904, 391
	97, 026, 000	106, 909, 000	108, 418, 000	119, 100, 000	123, 600, 000

[1] Gas-house coke is not included.
[2] Includes breeze.
[3] Production in 1925 is estimated at 695, 535 tons (Hsieh, C. Y., General Statement on the Mining Industry. China, Geol. Surv. Spec. Rept. No. 2, Peking, 1926). Similar figures not available for other years.
[4] Estimate included in total.
[5] Includes the Saar.
[6] In Great Britain the production of gas-house coke (including breeze), not included above, is especially important and was as follows: 1924, 12,279,666; 1925, 12,022,759; 1926, 11,784,401; 1927, 12,562,447; 1928, 12,411,903.
[7] Figures represent only coke made at collieries.
[8] Includes a small quantity of gas-house coke.
[9] Year ended Sept. 30.

COKE-OVEN BY-PRODUCTS

SUMMARY TABLES

The gross value of the by-products sold in 1928 was $151,309,528, the largest in the history of the by-product coke industry. (See Table 70.) This, however, does not include breeze or the value of tar used by the producer but not sold. If these two items are added the gross value of all by-products amounts to $177,000,000. (See Table 7.)

The most interesting development in the field of by-products during 1928 was the emergence of a number of by-product coke plants as producers of creosote oil. Including tar-distillation operations at Clairton, Pa., the total quantity of creosote oil recovered by by-product coke operators was 12,386,000 gallons. The quantity of coal-tar pitch produced at the same plants was reported as 54,131 tons. Except for the Clairton plant these new installations have seldom attempted to recover the phenol and other tar acids usually obtained in the refining of tar. Tar-distillation plants operated under separate corporations, even where financially affiliated with the corporation producing the coke, are not canvassed by the Bureau of Mines, but are covered by the United States Tariff Commission, to whose annual Census of Dyes and Other Synthetic Organic Chemicals the reader is referred for complete statistics on tar-refining operations.

TABLE 70.—*By-products obtained from coke-oven operations in the United States, 1927 and 1928*

[Exclusive of screenings and breeze]

Product	Production	Sales		
		Quantity	Value	
			Total	Average
1927				
Tar ----gallons..	546,859,205	305,898,176	$16,095,478	$0.053
Ammonia:				
Sulphate ----pounds..	1,216,141,460	1,267,753,969	24,802,926	.020
Ammonia liquor (NH_3 content) ----do....	54,694,723	53,994,327	2,580,342	.048
	----------	----------	27,383,268	----------
Sulphate equivalent of all forms ----do....	1,434,920,352	1,483,731,277	----------	----------
Gas:				
Used under boilers, etc ----M cubic feet..	[1] 700,894,799	25,848,762	1,866,342	.072
Used in steel or affiliated plants ----do....		244,969,339	26,580,340	.109
Distributed through city mains ----do....		106,910,108	36,249,081	.339
Sold for industrial use ----do....		30,661,148	5,396,405	.176
	----------	408,389,357	70,092,168	.172
Light oil and derivatives:				
Crude light oil ----gallons..	[2] 164,488,233	9,265,948	1,077,957	.116
Benzol, crude and refined ----do....	22,007,760	21,193,807	4,371,519	.206
Motor benzol ----do....	86,995,343	86,802,745	14,629,999	.169
Toluol, crude and refined ----do....	12,093,590	11,784,984	3,999,820	.339
Solvent naphtha and xylol ----do....	4,979,736	3,661,970	926,787	.253
Other light-oil products ----do....	3,155,031	1,393,876	147,017	.105
	[3] 129,231,460	134,103,330	25,153,099	.188
Naphthalene, crude ----pounds..	8,302,845	7,848,224	86,078	.011
Other products ----	----------	----------	93,791	----------
Value of all by-products sold ----	----------	----------	138,903,882	----------
1928 [4]				
Tar ----gallons..	631,844,767	332,150,270	17,544,797	.053
Ammonia:				
Sulphate ----pounds..	1,387,895,214	1,318,369,804	24,826,744	.019
Ammonia liquor (NH_3 content) ----do....	52,469,456	52,584,975	2,513,312	.048
	----------	----------	27,340,056	----------
Sulphate equivalent of all forms ----do....	1,597,773,038	1,528,709,704	----------	----------
Gas:				
Used under boilers, etc ----M cubic feet..	[1] 775,512,939	18,620,112	1,132,547	.061
Used in steel or affiliated plants ----do....		286,132,946	31,509,424	.110
Distributed through city mains ----do....		125,131,465	39,935,641	.319
Sold for industrial use ----do....		24,588,049	3,921,245	.159
	----------	454,472,572	76,498,857	.168
Light oil and derivatives:				
Crude light oil ----gallons..	[2] 188,597,956	10,334,813	1,158,846	.121
Benzol, crude and refined ----do....	21,451,748	21,452,973	4,215,752	.197
Motor benzol ----do....	103,051,900	102,935,995	16,832,646	.164
Toluol, crude and refined ----do....	16,097,856	16,181,650	5,513,624	.341
Solvent naphtha and xylol ----do....	5,587,370	4,471,141	1,047,095	.234
Other light-oil products ----do....	3,114,531	1,388,106	111,844	.081
	[3] 149,303,405	156,764,678	28,879,807	.184
Naphthalene, crude and refined ----pounds..	12,182,143	10,937,429	135,693	.012
Creosote oil ----gallons..	12,386,000	7,377,816	910,318	----------
Phenol ----do....	57,794	66,607		
Pitch of tar ----net tons..	54,131	1,725		
Other products [5] ----	----------	----------		
Value of all by-products sold ----	----------	----------	151,309,528	----------

---

[1] Includes gas wasted and gas used for heating retorts.

[2] Refined on the premises to make the derived products shown: 1927, 161,072,729 gallons of crude oil; 1928, 182,998,384 gallons.

[3] Total gallons of derived products.

[4] Includes products of tar distillation conducted by coke-oven operators under same corporate name, excepting, however, phenol and other tar acids produced at Clairton, Pa., which are covered by report of the U. S. Tariff Commission.

[5] Sodium prussiate, carbolate, sulphur, smoke compound, and extil covering.

The general trends of by-product recoveries in recent years are indicated by Tables 71 to 75 and Figures 57 to 61. Yields per ton of coal carbonized have been increasing, particularly the yield of tar. (See Table 71 and fig. 57.) Unit prices of gas, tar, and toluol have increased, while prices of ammonia and benzol have declined. (See Table 73 and figs. 58, 60, and 61.) The result has been a notable shift in the relative gross receipts from the several products. (See Table 74 and fig. 59.) In 1913 ammonia furnished the largest gross income per ton of coke produced; during the war its position was taken by the benzol group; to-day both ammonia and the benzol group are subordinate to gas and even tar. In fact, gas has so far increased in value as to contribute 43 per cent of the value of all the by-products.

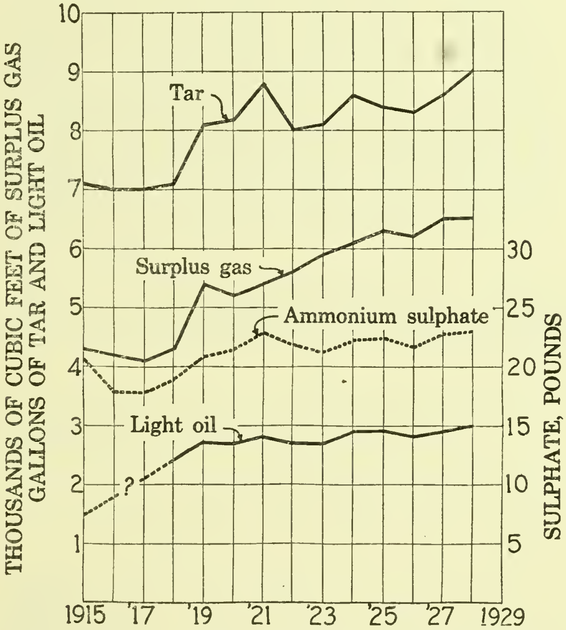

FIGURE 57.—Average yield of the principal by-products per net ton of coal carbonized in by-product coke ovens, 1915–1928. Figures for light oil represent the average at plants recovering light oil

TABLE 71.—*Average yield of coke and by-products per net ton of coal charged in by-product ovens in the United States, 1915, 1917, and 1922–1928*

Product	1915	1917	1922	1923	1924	1925	1926	1927	1928
Coke .... pounds	1,440	1,424	1,390	1,386	1,386	1,398	1,394	1,388	1,378
Tar .... gallons	7.1	7.0	8.0	8.1	8.6	8.4	8.3	8.6	9.0
Ammonium sulphate (or equivalent) .... pounds	20.1	17.8	21.9	21.2	22.2	22.4	21.7	22.7	22.8
Light oil .... gallons	1.5	(1)	[2] 2.7	[2] 2.7	[2] 2.9	[2] 2.9	[2] 2.8	[2] 2.9	[2] 3.0
Gas:									
Total .... M cubic feet	11.0	10.7	10.8	11.1	11.0	11.2	11.1	11.1	11.1
Surplus sold or used .... do	4.3	4.1	5.6	5.9	6.1	6.3	6.2	6.5	6.5
Burned in coking process .... do	6.3	6.0	5.0	5.0	4.7	4.7	4.7	4.4	4.3
Wasted .... do	.4	.6	.2	.2	.2	.2	.2	.2	.3

[1] Records not comparable.

[2] Average for plants recovering light oil.

TABLE 72.—*Coal equivalent of the by-products of by-product coking, 1914–1928*

Year	Quantity of by-products				Rough equivalent in heating value (billion B. t. u.)					Coal equivalent	
	1	2	3	4	5	6	7	8	9	10	11
	Coke breeze (thousand net tons)	Surplus gas (billion cubic feet)	Tar produced (thousand gallons)	Light oil produced (thousand gallons)	Coke breeze (1×20)	Surplus gas (2×550)	Tar (3× 0. 150)	Light oil (4× 0. 130)	Total (5+6+7+8)	Net tons (9÷0. 0262)	Per cent which this forms of coal made into coke
1914	667	61	109, 901	8, 464	13, 340	33, 550	16, 485	1, 100	64, 475	2, 461, 000	4. 8
1915	841	84	138, 415	16, 601	16, 820	46, 200	20, 762	2, 158	85, 940	3, 280, 000	5. 3
1916	1, 031	110	185, 506	43, 710	20, 620	60, 500	27, 826	5, 682	114, 628	4, 375, 000	5. 4
1917	1, 496	131	221, 999	54, 387	29, 920	72, 050	33, 300	7, 070	142, 340	5, 432, 000	6. 5
1918	1, 999	158	263, 299	87, 562	39, 980	86, 900	39, 495	11, 383	177, 758	6, 785, 000	8. 0
1919	1, 849	193	288, 902	92, 473	36, 980	106, 150	43, 335	12, 021	198, 486	7, 575, 000	11. 5
1920	2, 461	230	360, 664	109, 710	49, 220	126, 500	54, 100	14, 262	244, 082	9, 316, 000	12. 2
1921	1, 831	154	253, 052	76, 917	36, 620	84, 700	37, 958	9, 999	169, 277	6, 461, 000	17. 4
1922	2, 395	231	327, 780	101, 438	47, 900	127, 050	49, 167	13, 187	237, 304	9, 058, 000	16. 7
1923	3, 333	318	440, 907	135, 647	66, 660	174, 900	66, 136	17, 634	325, 330	12, 417, 000	14. 7
1924	2, 951	301	422, 074	128, 957	59, 020	165, 550	63, 311	16, 764	304, 645	11, 628, 000	17. 9
1925	3, 546	362	480, 849	146, 443	70, 920	199, 100	72, 127	19, 038	361, 185	13, 786, 000	18. 5
1926	4, 183	398	529, 486	164, 060	83, 660	218, 900	79, 423	21, 328	403, 311	15, 394, 000	18. 6
1927	4, 100	408	546, 859	164, 488	82, 000	224, 400	82, 029	21, 383	409, 812	15, 642, 000	21. 0
1928	4, 378	454	631, 845	188, 598	87, 560	249, 700	94, 777	24, 518	456, 555	17, 426, 000	22. 6

TABLE 73.—*Average receipts per unit of coke-oven by-products sold, 1913–1928*

[The figures in this table for 1913 to 1917 represent "average value of by-products produced and sold." For 1918 to 1928 they represent "average receipts from sales." The two sets of figures are probably comparable for practical purposes]

	Tar	Sulphate	Surplus gas	Benzol, refined	Motor benzol	Toluol, refined	Solvent naphtha	Naphthalene	
								Crude	Refined
Unit	Gallon	Pound	M cubic feet	Gallon	Gallon	Gallon	Gallon	Pound	Pound
	Cents	*Cents*	*Cents*	*Cents*	*Cents*		*Cents*	*Cents*	
1913	2. 5	3. 1	8. 8	[1] 27. 0	(2)	[1] $0. 29	[1] 25. 0	(2)	
1914	2. 6	2. 8	9. 8	[1] 26. 0	(2)	[1]. 33	[1] 25. 0	(2)	
1915	2. 6	2. 8	10. 2	56. 8	(3)	2. 45	24. 0	[4] 10. 0	
1916	2. 6	3. 1	9. 8	62. 4	(3)	2. 85	28. 4	[4] 3. 4	
1917	2. 7	3. 4	8. 7	45. 0	(3)	1. 37	16. 6	[4] 3. 3	
1918	3. 2	4. 5	8. 7	27. 5	(3)	1. 43	14. 1	2. 8	6. 6
1919	3. 2	3. 8	8. 6	20. 6	(5)	. 263	15. 2	2. 0	4. 1
1920	3. 7	4. 3	14. 0	26. 0	22. 7	. 300	18. 1	2. 7	6. 1
1921	4. 2	2. 5	16. 8	23. 9	17. 9	. 283	17. 7	2. 5	5. 6
1922	4. 0	2. 5	16. 7	28. 5	19. 1	. 292	18. 8	1. 6	5. 0
1923	4. 4	2. 9	16. 2	24. 8	16. 3	. 291	17. 9	1. 7	5. 5
1924	4. 6	2. 4	16. 5	20. 9	15. 2	. 241	18. 7	1. 5	3. 6
1925	4. 9	2. 3	17. 0	22. 4	16. 6	. 261	20. 2	1. 0	2. 5
1926	5. 1	2. 1	16. 3	22. 8	18. 8	. 338	29. 2	1. 3	(6)
1927	5. 3	2. 0	17. 2	[4] 20. 6	16. 9	. 340	25. 3	1. 1	---------
1928	5. 3	1. 9	16. 8	[4] 19. 7	16. 4	[4]. 341	23. 4	[4] 1. 2	

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[1] Trade quotations, New York market; used to avoid disclosing individual operators' reports.
[2] No data.
[3] Not reported during the war.
[4] Crude and refined not separated.
[5] Data uncertain.
[6] Sales too small to be representative.

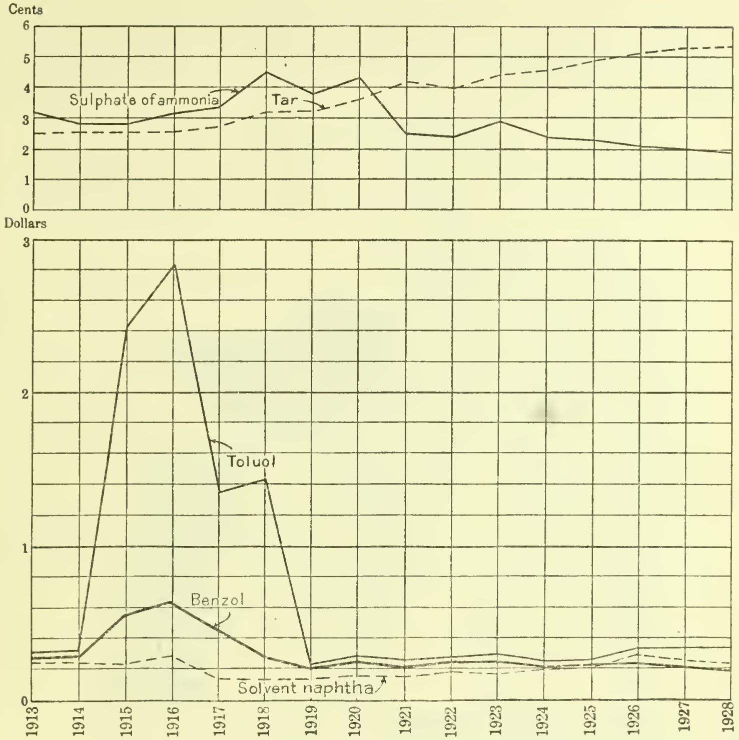

FIGURE 58.—Average receipts per unit for the principal refined light oils and other products at by-product coke plants, 1913–1928. The figures for tar and sulphate of ammonia represent cents per pound; the figures for light oils represent dollars per gallon

TABLE 74.—*Value of by-products and of coke, including breeze, per ton of coke produced in the United States, 1915, 1917, 1918, and 1922–1928*

Product	1915	1917	1918	1922	1923	1924	1925	1926	1927	1928
Ammonia and its compounds	$0.70	$0.79	$1.02	$0.78	$0.84	$0.80	$0.69	$0.63	$0.62	$0.57
Light oil and its derivatives (including naphthalene)	.52	1.30	.99	.55	.51	.50	.54	.62	.58	.60
Surplus gas sold or used	.61	.51	.53	1.35	1.37	1.46	1.54	1.46	1.60	1.58
Tar sold	.25	.25	.24	.22	.25	.28	.30	.32	.37	.36
Miscellaneous products	.03	.06	.09	.01	.01					.02
	2.11	2.91	2.87	2.91	2.98	3.04	3.07	3.03	3.17	3.13
Tar used, not sold	(1)	(1)	.08	.23	.26	.29	.29	.28	.29	.33
Breeze produced	(2)	.10	.12	.18	.24	.18	.22	.21	.20	.20
Total value of by-products including those not sold	2.19	3.01	3.07	3.32	3.48	3.51	3.58	3.52	3.66	3.66
Value of coke produced	3.45	6.18	[3] 7.42	[3] 6.59	[3] 6.85	[3] 5.76	[3] 5.28	[3] 5.65	[3] 5.29	[3] 4.90
Total value of coke and by-products	5.64	9.19	10.49	9.91	10.33	9.27	8.86	9.17	8.95	8.56

[1] Included in tar sold.

[2] Estimate included in total.

[3] The average receipts per ton of coke sold during these years were $8.45 in 1922, $8.53 in 1923, $6.90 in 1924, $6.61 in 1925, $6.95 in 1926, $6.57 in 1927, and $5.95 in 1928.

The figures given in Table 74 and Figure 59 are a composite of the experience of all by-product coke plants and are dominated by the large establishments associated with iron furnaces, at which gas is credited at relatively low prices. Table 75 has been prepared to show the experience at nonfurnace or merchant plants only. (See pp. 721 and 728 for definition of furnace and merchant plants.) At these nonfurnace plants the gross value of gas per ton of coke produced in 1928 was $3.39, or nearly double the average for all plants.

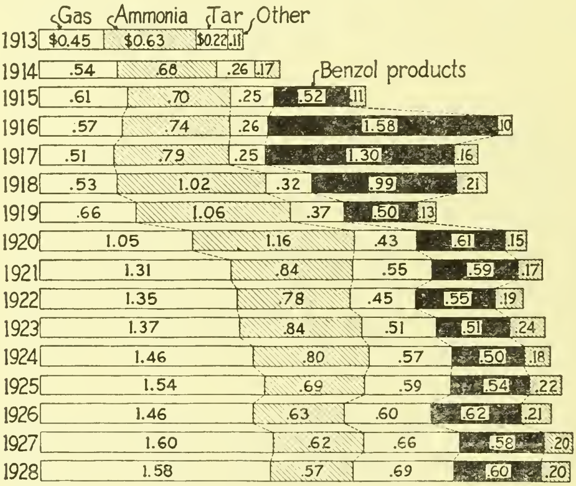

FIGURE 59.—Gross value of the several by-products per ton of by-product coke produced, 1913–1928

TABLE 75.—*Gross value f. o. b. plant of all products reported by nonfurnace by-product coke plants, 1928*

[Values added by distribution not included. Plants include by-product plants operated by city gas companies and alkali manufacturers as well as merchant coke plants]

Product	Total value	Per cent of total value	Value per ton of coke produced	Value per M cubic feet of surplus gas produced
Coke:				
Used by producer	$6,310,000	5.4	----------	$0.059
Sold for furnace use	9,868,000	8.4	----------	.092
Sold for foundry use	12,740,000	10.8	----------	.119
Sold for other industrial use	6,610,000	5.6	----------	.062
Sold for domestic use	30,200,000	25.6	----------	.282
Total	65,728,000	55.8	$6.53	.614
Breeze:				
Used by producer for steam raising or other use	1,564,000	1.3	----------	----------
Sold	498,000	.4	----------	----------
Total	2,062,000	1.7	.21	.019
Tar	6,515,000	5.5	.65	.061
Ammonia	5,556,220	4.7	.55	.052
Surplus gas:				
Used under boilers	320,625	.3	----------	----------
Used in affiliated plants	159,307	.1	----------	----------
Distributed through city mains	32,461,982	27.5	----------	----------
Sold for industrial use	1,167,052	1.0	----------	----------
Total	34,108,966	28.9	3.39	.319
Light-oil products	4,039,852	3.4	.40	.038
Naphthalene	1,609	----------	----------	----------
Total gross value	118,011,647	100.0	11.73	1.103
Cost of coal carbonized	61,493,381	----------	6.10	.574

TAR

TABLE 76.—*Coke-oven tar produced and sold in the United States in 1928, by States.*

State	Produced (gallons)		Sold		
	Total	Per ton of coal coked	Gallons	Value	
				Total	Average
Alabama	57, 888, 814	9. 3	35, 733, 211	$1, 923, 492	$0. 054
Colorado	8, 720, 000	9. 8	9, 664	(1)	(1)
Illinois	38, 633, 272	8. 2	31, 535, 231	1, 637, 271	. 052
Indiana	50, 846, 232	6. 2	25, 355, 250	1, 248, 019	. 049
Maryland	12, 499, 005	7. 6	11, 960, 453	(1)	(1)
Massachusetts	9, 292, 910	9. 0	9, 308, 021	523, 234	. 056
Michigan	27, 692, 750	8. 2	11, 553, 858	659, 096	. 057
Minnesota	6, 507, 071	7. 2	5, 131, 624	282, 263	. 055
New Jersey	10, 270, 738	8. 2	10, 412, 681	(1)	(1)
New York	50, 286, 638	9. 1	37, 207, 307	2, 160, 644	. 058
Ohio	102, 088, 417	8. 9	51, 671, 719	2, 790, 648	. 054
Pennsylvania	214, 126, 173	10. 5	65, 782, 499	3, 060, 850	. 047
Tennessee	1, 123, 618	7. 4	1, 148, 886	47, 753	. 042
Utah	5, 251, 100	11. 7	5, 216, 300	(1)	(1)
Washington	509, 735	7. 9	537, 189	37, 603	. 070
West Virginia	20, 560, 549	10. 5	17, 678, 819	961, 386	. 054
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	15, 547, 745	7. 8	11, 907, 558	639, 738	. 054
Undistributed				1, 572, 800	. 057
	631, 844, 767	9. 0	332, 150, 270	17, 544, 797	. 053

State	Used (gallons)			On hand Dec. 31 (gallons)
	As fuel under boilers	In open-hearth or affiliated plants	Otherwise	
Alabama	(1)	(1)	410, 664	3, 109, 469
Colorado		8, 586, 537	14, 772	171, 052
Illinois		(1)	3, 000	3, 869, 633
Indiana		24, 498, 733	(1)	3, 130, 833
Maryland		28, 264		1, 377, 967
Massachusetts				1, 986, 773
Michigan	(1)	(1)		2, 997, 136
Minnesota		(1)		345, 552
New Jersey				443, 669
New York	(1)	(1)	(1)	3, 838, 448
Ohio	2, 808, 994	45, 873, 640	(1)	5, 444, 434
Pennsylvania	535, 730	125, 507, 722	86, 506	8, 739, 783
Tennessee				65, 155
Utah				125, 178
Washington			1, 424	20, 184
West Virginia		2, 666, 512		677, 201
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin				2, 141, 736
Undistributed	1, 988, 053	50, 525, 917	72, 490	
	5, 332, 777	257, 687, 325	588, 856	38, 484, 203

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[1] Included under "Undistributed."

TABLE 77.—*Average yield of coke-oven tar, by States, 1922–1928*

[Figures represent gallons per ton of coal charged]

State	1922	1923	1924	1925	1926	1927	1928	Average for 7 years shown
Alabama	8.6	8.3	8.2	8.4	8.7	9.0	9.3	8.7
Colorado	10.1	10.1	9.5	10.4	10.7	10.5	9.8	10.2
Illinois	8.1	7.3	7.9	7.9	7.7	8.3	8.2	7.9
Indiana	5.9	6.2	6.1	5.9	5.8	6.1	6.2	6.0
Maryland	6.9	7.0	6.8	6.9	6.5	6.8	7.6	6.9
Massachusetts	6.5	7.9	8.3	7.5	8.9	9.2	9.0	8.2
Michigan	7.3	7.1	7.6	7.4	7.3	7.5	8.2	7.5
Minnesota	7.5	7.7	8.4	8.0	7.3	7.0	7.2	7.6
New Jersey	8.7	7.9	8.4	8.1	8.0	7.8	8.2	8.2
New York	8.5	8.7	8.7	8.6	8.8	9.0	9.1	8.8
Ohio	8.1	8.5	9.0	9.1	8.6	8.8	8.9	8.7
Pennsylvania	8.6	9.1	9.9	9.3	9.4	9.7	10.5	9.5
Tennessee	8.7	2.6	8.9	8.2	7.5	7.4	7.4	7.2
Utah	--------	--------	10.4	11.3	11.4	12.0	11.7	11.4
Washington	6.3	7.3	8.2	8.1	7.9	7.5	7.9	7.6
West Virginia	8.9	10.7	11.3	10.2	10.1	10.0	10.5	10.2
Connecticut,[1] Kentucky, Missouri, Rhode Island, and Wisconsin	7.9	7.5	8.3	8.0	7.2	8.2	7.8	7.8
United States	8.0	8.1	8.6	8.4	8.3	8.6	9.0	8.4

[1] 1928 first year of production.

TABLE 78.—*Disposal of coke-oven tar produced in the United States, 1927 and 1928, in gallons*

	1927			1928		
	Furnace plants	Other plants	Total	Furnace plants	Other plants	Total
Sold	197,429,480	108,468,696	305,898,176	222,766,734	109,383,536	332,150,270
Used:						
As fuel under boilers	6,813,532	24,500	6,838,032	4,383,254	949,523	5,332,777
In open-hearth or other metallurgical plants	225,345,259	------------	225,345,259	257,687,325	------------	257,687,325
Refined at plant	------------	------------	------------	(1)	(1)	23,557,527

[1] Not at liberty to publish.

TABLE 79.—*Per cent of coke-oven tar sold and per cent used by the producer, 1918–1928* [1]

Year	Sold	Used by producer	Year	Sold	Used by producer
1918	76.0	24.0	1924	49.7	50.3
1919	75.4	24.6	1925	49.9	50.1
1920	48.3	51.7	1926	52.4	47.6
1921	53.5	46.5	1927	55.9	44.1
1922	49.5	50.5	1928	52.6	47.4
1923	48.0	52.0			

[1] The percentage "used by the producer" consists largely of tar consumed in steel furnaces; this percentage would be still larger if deliveries by the coke-oven company to a separate but affiliated corporation were included. Such deliveries are usually reported as "sales" and can not be accurately separated, but from general information it appears that in 1928 they amounted to about 6 per cent of the total production. Were they counted as "used" the per cent used would therefore be 53.4 and the per cent sold would be 46.6. In computing these percentages no account is taken of changes in stocks.

TABLE 80.—*Production and sales of coke-oven, coal-gas, water-gas, and oil-gas tar in the United States, 1918–1928*

	Coke-oven tar [1]	Coal-gas tar [2]	Total coal tar	Water and oil gas tar
Production (gallons):				
1918	263, 299, 470	52, 694, 826	315, 994, 296	100, 985, 156
1919	288, 901, 739	53, 146, 421	342, 048, 160	[3] 105, 318, 339
1920	360, 664, 124	51, 264, 956	411, 929, 080	116, 073, 907
1921	253, 051, 649	(4)	309, 051, 649	(5)
1922	327, 779, 734	48, 082, 228	375, 861, 962	104, 555, 028
1923	440, 907, 109	(4)	493, 407, 109	(5)
1924	422, 074, 326	(6)	475, 074, 326	(5)
1925	480, 848, 814	(4)	534, 848, 814	(5)
1926	529, 486, 374	(6)	583, 486, 374	(5)
1927	546, 859, 205	(6)	600, 859, 205	(5)
1928	631, 844, 767	(6)	688, 344, 767	(5)
Sales (gallons):				
1918	200, 233, 002	47, 727, 839	247, 960, 841	55, 283, 484
1919	217, 707, 157	49, 307, 852	267, 015, 009	[3] 58, 557, 947
1920	174, 363, 696	46, 604, 133	220, 967, 829	59, 238, 730
1921	135, 293, 047	51, 976, 307	187, 269, 354	[3] 53, 432, 945
1922	162, 204, 417	41, 266, 074	203, 470, 491	47, 338, 489
1923	211, 739, 469	47, 840, 512	259, 579, 081	[3] 49, 990, 820
1924	209, 979, 999	(6)	258, 479, 999	(5)
1925	240, 160, 986	49, 175, 979	289, 336, 965	[3] 61, 471, 124
1926	277, 248, 522	(6)	326, 248, 522	(5)
1927	305, 898, 176	[7] 51, 266, 279	[7] 357, 164, 455	[3] 83, 479, 339
1928	332, 150, 270	(6)	383, 150, 270	(5)
Value of sales:				
1918	$6, 364, 972	$1, 863, 580	$8, 228, 552	$1, 805, 865
1919	6, 918, 549	2, 156, 471	9, 075, 020	[3] 2, 012, 723
1920	6, 378, 040	2, 010, 186	8, 388, 226	2, 109, 388
1921	5, 645, 309	2, 811, 728	8, 457, 037	[3] 2, 192, 015
1922	6, 419, 743	1, 955, 950	8, 375, 693	1, 879, 490
1923	9, 250, 552	2, 461, 691	11, 712, 243	[3] 2, 001, 363
1924	9, 623, 520	(6)	12, 293, 520	(5)
1925	11, 903, 196	2, 750, 719	14, 653, 915	[3] 2, 594, 025
1926	14, 103, 760	(6)	16, 803, 760	(5)
1927	16, 095, 478	[7] 2, 923, 819	[7] 19, 019, 297	[3] 3, 768, 464
1928	17, 544, 797	(6)	20, 454, 797	(5)

[1] Includes tar produced in by-product coke ovens operated by city gas companies.

[2] The figures here given for coal-gas tar include only the operations of coal-gas retorts. For 1918, 1920, and 1922 they are taken from special studies by the U. S. Geological Survey. For 1919, 1921, 1923, 1925, and 1927, revised census figures are used, obtained by subtracting from the totals for the manufactured-gas industry, as published by the Census Bureau, the tar produced at by-product coke ovens operated by city gas companies.

[3] As reported by the Bureau of the Census.

[4] Estimate included in total, based upon reported sales as given below.

[5] No data. [6] Estimate included in total. [7] Revised since last report.

AMMONIA

TABLE 81.—*Ammonia produced at coke-oven plants, by States, in 1928, in pounds*

State	Sulphate	Liquor (NH_3 content)	Sulphate equivalent of all forms	
			Total	Per ton of coal coked
Alabama	(1)	(1)	157, 776, 042	25. 4
Colorado	18, 321, 000		18, 321, 000	20. 6
Illinois	(1)	(1)	110, 339, 068	23. 4
Indiana	122, 027, 492	5, 391, 313	143, 592, 744	17. 5
Maryland	33, 833, 594		33, 833, 594	20. 7
Massachusetts	(1)	(1)	21, 326, 413	20. 6
Michigan	(1)	(1)	78, 003, 466	23. 0
Minnesota	(1)	(1)	17, 988, 489	20. 0
New Jersey	28, 443, 739		28, 443, 739	22. 7
New York	(1)	(1)	126, 850, 047	23. 1
Ohio	[2] 705, 469, 422	[2] 11, 155, 951	269, 135, 579	23. 5
Pennsylvania			480, 957, 647	23. 7
Tennessee	3, 233, 406		3, 233, 406	21. 4
Utah	13, 075, 530		13, 075, 530	29. 2
Washington		528, 368	2, 113, 472	32. 8
West Virginia	46, 708, 129		46, 708, 129	23. 8
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	(1)	(1)	46, 074, 673	23. 0
Undistributed	416, 782, 902	35, 393, 824		
	1, 387, 895, 214	52, 469, 456	1, 597, 773, 038	22. 8

[1] Included under "Undistributed."

[2] Figures for Ohio and Pennsylvania combined to avoid disclosing individual operations.

TABLE 82.—*Yield of ammonium sulphate equivalent reported by coke-oven plants in 1921, 1922, and 1928*

	1921	1922	1928
Total ammonium sulphate or equivalent recovered..pounds..	657,001,003	898,465,061	1,597,773,038
Yield of sulphate per ton of coal coked:			
At plant reporting minimum average yield..........do....	3.6	14.2	6.3
At plant reporting maximum average yield..........do....	30.3	29.9	32.8
At average plant[1]..........do....	21.9	22.1	22.9
Average yield for all coal coked[2]..........do....	22.8	21.9	22.8
Total number of plants reporting recovery of ammonia......	67	64	85
Number of plants recovering—			
Less than 10 pounds per ton of coal	2	....	1
10–14.9 pounds	2	2	2
15–19.9 pounds	14	14	6
20–21.9 pounds	11	13	20
22–23.9 pounds	13	17	24
24–25.9 pounds	15	10	18
26–27.9 pounds	3	5	12
28–29.9 pounds	6	3	1
30 pounds or more	1	....	1

[1] Sum of averages for all plants divided by number of plants.

[2] Total yield in sulphate equivalent divided by number of tons of coal carbonized.

TABLE 83.—*Average monthly prices of sulphate of ammonia per 100 pounds, 1913–1928*

[Quotations, 1913–1916, abstracted from Oil, Paint, and Drug Reporter, at New York; 1917–1928, from Iron Trade Review, f. o. b. producers' works. Figures for 1913-1922 compiled by C. G. Atwater, of the Barrett Co.]

Month	1913	1914	1915	1916	1917	1918	1919	1920
January	$3.28	$2.90	$2.71¼	$3.96½	$4.12	$5.03	$4.68	$4.00
February	3.30	2.85	2.98¾	3.96¼	4.18	5.22½	4.50	4.00
March	3.30	2.85	3.16	3.92½	(1)	5.40½	4.25	4.55
April	3.30	2.85	3.10⅝	3.68¾	(1)	5.46	4.00	4.55
May	3.30	2.70	3.20	3.57½	4.72½	5.59½	3.80	4.55
June	3.12	2.55	3.22½	3.53	4.80	5.10	3.60	4.55
July	3.00	2.52	3.41	3.43½	4.90	4.50	3.40	4.55
August	2.98	2.60	3.53	3.58¾	4.90	4.50	3.53	4.80
September	3.07	2.76⅞	3.37½	3.77½	4.92½	4.50	3.53	4.80
October	3.10	2.67½	3.37½	4.02½	4.95	4.50	3.57	4.25
November	3.06¼	2.67½	3.57	4.21¼	4.92½	4.50	3.78	3.75
December	2.95	2.67½	3.93¾	4.32½	4.90	4.86	3.93	3.38
Average	3.14	2.71	3.30	3.83	4.73	4.93	3.88	4.31

Month	1921	1922	1923	1924	1925	1926	1927	1928
January	$3.37½	$2.20	$3.10	$2.72½	$2.67½	$2.82½	$2.50	$2.325
February	3.12½	2.35	3.15⅝	2.72½	2.62½	2.72½	2.52½	2.325
March	2.92½	2.60½	3.19½	2.72½	2.52½	2.68½	2.52½	2.35
April	2.57½	2.65	3.22½	2.65	2.52½	2.62½	2.50	2.35
May	2.45	2.67	3.21½	2.62½	2.42½	2.62½	2.42	2.35
June	2.45	2.72	3.13¾	2.57½	2.37½	2.50	2.42	2.20
July	2.35	2.82	3.10	2.50	2.67½	2.47½	2.25	2.20
August	2.00	2.82	3.07½	2.35	2.75	2.47½	2.25	2.20
September	1.95	2.90	3.02½	2.50	2.80	2.47½	2.30	2.20
October	2.20	3.05	3.01¼	2.60	2.95	2.47½	2.32½	2.30
November	2.20	3.07	2.93¾	2.65	2.85	2.47½	2.32½	2.30
December	2.20	3.12	2.76¼	2.67½	2.80	2.47½	2.32½	2.30
Average	2.48	2.75	3.08	2.61	2.66	2.57	2.39	2.28

(1) No market.

LIGHT OIL AND ITS DERIVATIVES

TABLE 84.—*Number of plants making light oil or derivatives, by States, 1927 and 1928*

State	1927				1928			
	Total making coke	Making crude light oil	Making any refined product	Making motor benzol	Total making coke	Making crude light oil	Making any refined product	Making motor benzol
Alabama	8	8	6	6	8	8	6	6
Colorado	1	1	1	1	1	1	1	1
Illinois	6	4	3	2	8	4	3	2
Indiana	7	4	4	4	7	4	4	4
Maryland	1	1	1	1	1	1	1	1
Massachusetts	3	--------	--------	--------	3	--------	--------	--------
Michigan	6	2	1	1	7	3	2	2
Minnesota	3	1	1	1	3	1	1	1
New Jersey	2	--------	--------	--------	2	--------	--------	--------
New York	8	7	6	6	9	7	6	6
Ohio	14	13	11	11	15	15	13	13
Pennsylvania	10	9	8	8	10	9	8	8
Tennessee	1	1	1	1	1	1	1	1
Utah	1	1	1	1	1	1	1	1
Washington	1	--------	--------	--------	1	--------	--------	--------
West Virginia	3	3	3	2	3	3	3	3
Connecticut,[1] Kentucky, Missouri, Rhode Island, and Wisconsin	4	3	2	--------	5	3	3	--------
	79	58	49	45	85	61	53	49

[1] Not included in 1927.

TABLE 85.—*Crude light oil produced at coke-oven plants in the United States in 1928, by States, in gallons*[1]

State	Average yield per ton of coal coked	Produced	Refined on the premises	Total derived products obtained from refining operations
Alabama	3.0	18,428,944	17,080,608	14,415,108
Colorado	3.2	2,834,127	2,830,386	2,258,233
Illinois	2.8	10,070,369	6,621,210	5,047,436
Indiana	2.7	20,348,753	20,337,731	16,960,277
Maryland	2.6	4,316,092	4,295,025	3,534,326
New York	2.8	13,312,889	19,279,981	16,308,356
Ohio	3.1	35,156,832	32,709,055	25,884,421
Pennsylvania	3.2	64,095,947	63,618,252	51,544,252
Tennessee	2.6	392,853	391,520	326,822
Utah	3.6	1,609,235	1,609,235	1,298,140
West Virginia	3.2	6,265,282	6,222,878	4,880,538
Kentucky, Michigan, Minnesota, Missouri, and Wisconsin	2.4	11,766,633	8,002,503	6,845,496
	3.0	188,597,956	182,998,384	149,303,405

[1] In addition to the quantity refined on the premises, a few plants reported the sale of crude light oil. The total quantity sold in 1928 was 10,334,813 gallons, valued at $1,158,846, or 11.2 cents per gallon.

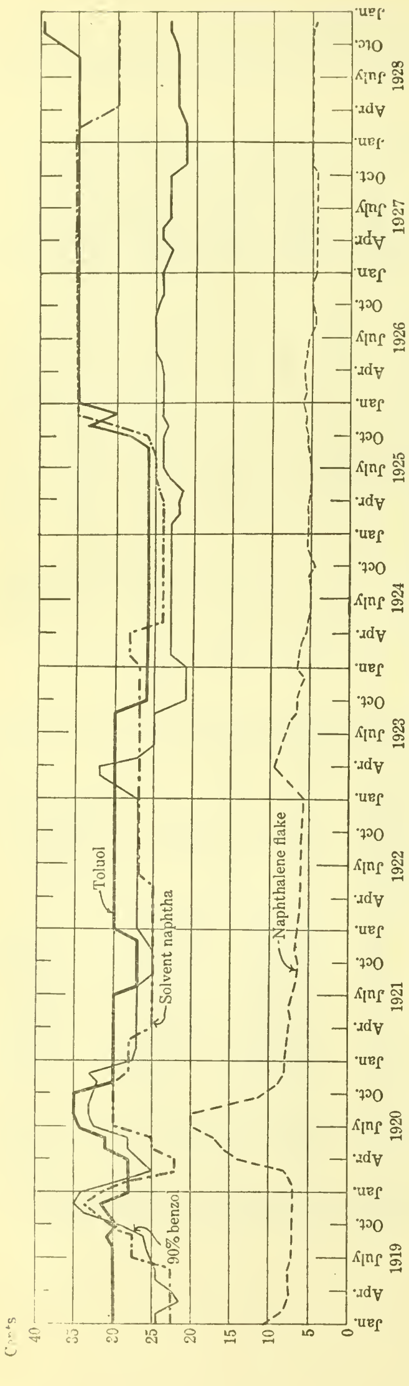

FIGURE 60.—Spot prices of 90 per cent benzol, toluol, solvent naphtha, and flake naphthalene at New York, 1919–1928

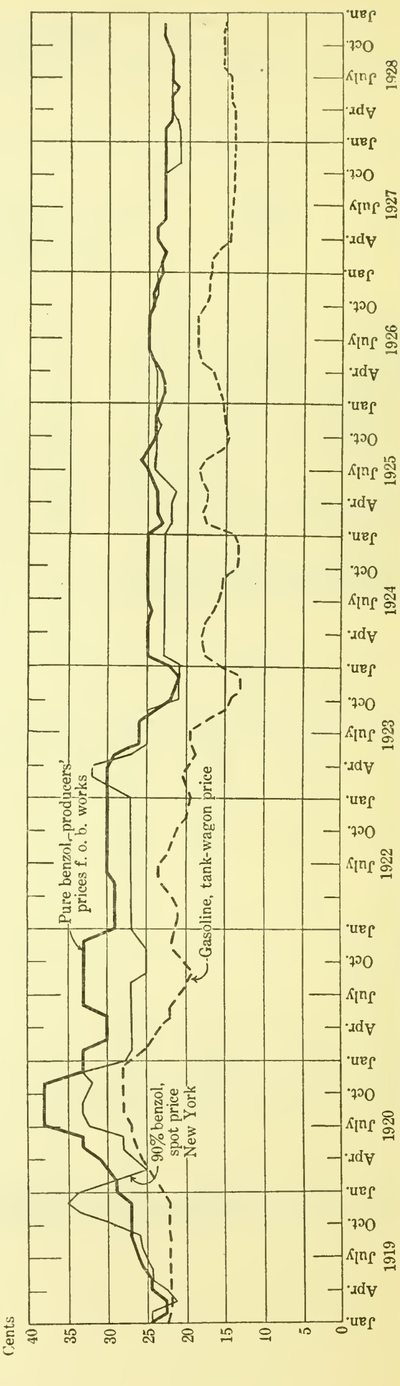

FIGURE 61.—Average price of 90 per cent benzol in New York, producers' prices of pure benzol f. o. b. works, and tank-wagon price of gasoline, 1919–1928

TABLE 86.—*Production of motor fuel in the United States, 1918–1928, in gallons*

Year	Gasoline production of petroleum refineries	Natural gasoline (total production)	Benzol produced, all grades, including motor benzol		
			Coke ovens	Gas works, including oil and water gas	Tar refineries etc.[1]
1918	3,570,000,000	283,000,000	44,805,000	[2] 5,633,000	3,015,000
1919	3,958,000,000	352,000,000	61,068,000	(3)	1,826,000
1920	4,883,000,000	385,000,000	72,994,000	[4] 502,000	876,000
1921	5,154,000,000	450,000,000	54,459,000	(5)	2,172,000
1922	6,202,000,000	506,000,000	70,112,000	(5)	[6] 775,000
1923	7,556,000,000	816,000,000	97,335,000	(5)	[6] 395,000
1924	8,960,000,000	934,000,000	91,904,000	(5)	[6] 630,000
1925	10,903,000,000	1,127,000,000	103,821,000	(5)	[6] 742,000
1926	12,589,000,000	1,363,000,000	112,489,000	(5)	[6] 377,000
1927	13,878,000,000	1,641,000,000	109,003,000	(5)	[6] 371,000
1928	15,832,000,000	1,814,000,000	124,504,000	(5)	[6] 474,000

[1] As reported to the U. S. Tariff Commission.

[2] Of this only 2,177,000 gallons was sold, the balance being returned to the gas.

[3] Data not available in comparable form.

[4] Quantity sold, used because of apparent double counting between production figures of crude and refined benzol.

[5] Can not be shown without disclosing individual returns.

[6] Does not include a small amount of motor benzol which can not be shown without disclosing individual returns.

TABLE 87.—*Producers' price per gallon of pure benzol f. o. b. works and tank-wagon price of gasoline, 1924–1928, by months*

[Prices of benzol are those quoted by Iron Trade Review; of tank-wagon gasoline, average for 5 cities computed by J. E. Pogue and published in Commerce Yearbook, 1929, vol. 1, p. 321]

Month	1924		1925		1926		1927		1928	
	Benzol	Gasoline	Benzol	Gasoline	Benzol	Gasoline	Benzol	Gasoline	Benzol	Gasoline
January	$0.220	$0.152	$0.250	$0.141	$0.235	$0.154	$0.235	$0.171	$0.23	$0.142
February	.250	.177	.230	.175	.230	.159	.235	.168	.23	.142
March	.250	.180	.240	.180	.230	.164	.23	.159	.22	.142
April	.250	.180	.240	.175	.235	.169	.24	.149	.22	.142
May	.250	.178	.240	.174	.245	.182	.24	.149	.22	.144
June	.245	.169	.245	.181	.250	.186	.23	.145	.215	.144
July	.250	.159	.250	.184	.250	.186	.23	.146	.22	.144
August	.250	.154	.260	.177	.250	.186	.23	.143	.22	.154
September	.250	.151	.250	.151	.250	.186	.23	.142	.22	.154
October	.250	.136	.240	.148	.245	.178	.23	.142	.225	.154
November	.250	.134	.240	.150	.245	.174	.23	.142	.23	.153
December	.250	.134	.240	.152	.240	.174	.23	.142	.23	.150
Average	.247	.159	.244	.166	.242	.175	.233	.150	.223	.147

TABLE 88.—*Monthly spot prices of coal-tar products in New York market, 1924–1928*

[As quoted by Oil, Paint, and Drug Reporter. Figures are averages of high and low quotations for each month]

Month	Benzol (90 per cent), per gallon					Toluol, per gallon				
	1924	1925	1926	1927	1928	1924	1925	1926	1927	1928
January	$0.210	$0.230	$0.240	$0.240	$0.210	$0.260	$0.260	$0.350	$0.350	$0.350
February	.230	.220	.240	.235	.210	.260	.260	.350	.350	.350
March	.230	.220	.240	.230	.215	.260	.260	.350	.350	.350
April	.230	.220	.240	.240	.220	.260	.260	.350	.350	.350
May	.230	.215	.245	.240	.220	.260	.260	.350	.350	.350
June	.230	.230	.250	.230	.220	.260	.260	.350	.350	.350
July	.230	.240	.250	.230	.220	.260	.260	.350	.350	.350
August	.230	.240	.250	.230	.220	.260	.260	.350	.350	.350
September	.230	.240	.250	.230	.220	.260	.260	.350	.350	.350
October	.230	.240	.245	.230	.225	.260	.285	.350	.350	.375
November	.230	.235	.240	.210	.230	.260	.330	.350	.350	.400
December	.230	.240	.240	.210	.230	.260	.300	.350	.350	.400
Average	.228	.225	.244	.230	.220	.260	.271	.350	.350	.375

TABLE 88.—*Monthly spot prices of coal-tar products in New York market, 1924–1928*—Continued

Month	Solvent naphtha, per gallon					Naphthalene flakes, per pound				
	1924	1925	1926	1927	1928	1924	1925	1926	1927	1928
January	$0.270	$0.240	$0.350	$0.350	$0.350	$0.065	$0.055	$0.061	$0.045	$0.050
February	.280	.240	.350	.350	.350	.063	.055	.058	.045	.050
March	.280	.240	.350	.350	.325	.061	.055	.060	.045	.050
April	.280	.240	.350	.350	.300	.055	.053	.060	.045	.050
May	.240	.245	.350	.350	.300	.053	.050	.059	.045	.050
June	.240	.250	.350	.350	.300	.050	.050	.058	.045	.050
July	.240	.250	.350	.350	.300	.050	.050	.053	.045	.050
August	.240	.250	.350	.350	.300	.050	.053	.048	.045	.050
September	.240	.255	.350	.350	.300	.053	.055	.048	.045	.050
October	.240	.260	.350	.350	.300	.045	.055	.050	.048	.050
November	.240	.305	.350	.350	.300	.050	.058	.050	.050	.048
December	.240	.350	.350	.350	.300	.055	.058	.050	.050	.045
Average	.253	.260	.350	.350	.325	.055	.054	.055	.046	.048

COKE-OVEN GAS

As gas is now the most valuable coke-oven by-product (fig. 59), it is given special attention in the following tables. Tables 89 to 91 give details of the quantities recovered, used, and sold in 1928, by States. Table 92 traces the disposition made of the surplus gas from year to year. (See also fig. 63.) In the period since 1923 there has been a decrease in the amount of gas used for boiler fuel and a remarkable increase in that used in open-hearth furnaces or other affiliated works and in that distributed through city mains.

A notable development in recent years has been the use of lean gases, such as producer gas or blue water gas, made from breeze or small coke, for heating the coke ovens, thereby releasing large quantities of oven gas for sale. To record the progress made in this development the bureau has collected statistics of gases used for underfiring the ovens, the results of which are shown in Table 93. Of 85 by-product plants operating in 1928, 18 reported the use of producer gas, 5 of blue water gas, and 2 of blast-furnace gas, either alone or in combination. Most of these plants continued to use oven gas for at least a portion of the time. The total quantity of producer gas fired was 62,652,204 M cubic feet; of blue water gas, 2,391,378 M cubic feet; and of blast-furnace gas, 3,948,393 M cubic feet.

The application of these lean gases to heating the ovens is one of the causes underlying the remarkable advance in the proportion of the total production of coke-oven gas available for use or sale. (See Table 94 and fig. 62.)

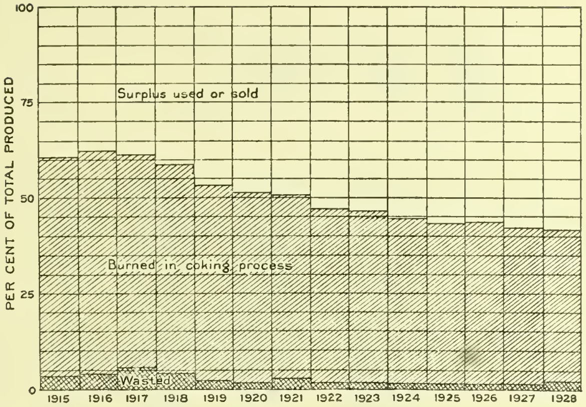

FIGURE 62.—Per cent of total production of by-product oven gas that was wasted, burned in coking processes, or sold or used, 1915–1928. The increasing surplus used or sold is in part due to the practice of firing the ovens with producer-gas, blue water gas, or blast-furnace gas

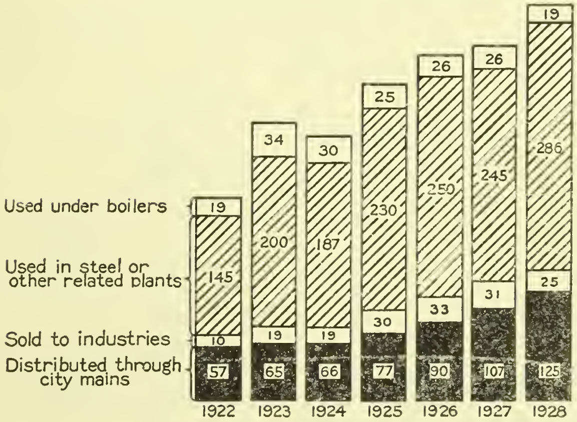

FIGURE 63.—Disposition of surplus coke-oven gas, 1922–1928. Gas used in heating ovens or wasted is not included. Figures in bars represent billion cubic feet

TABLE 89.—*Coke-oven gas produced and sold in the United States in 1928, by States*

State	Number of active plants	Produced (M cubic feet)	Used in process (M cubic feet)	Surplus sold or used			Wasted (M cubic feet)
				M cubic feet	Value		
					Total	Average	
Alabama	8	70, 471, 636	28, 381, 376	38, 617, 799	$3, 029, 115	$0. 078	3, 472, 461
Colorado	1	10, 515, 600	4, 206, 785	5, 833, 275	(1)	(1)	475, 540
Illinois	8	49, 601, 546	17, 423, 588	32, 119, 525	6, 937, 053	. 216	58, 433
Indiana	7	88, 637, 172	39, 019, 594	48, 662, 901	9, 708, 582	. 200	954, 677
Maryland	1	18, 454, 002	6, 104, 903	12, 349, 099	(1)	(1)	----------
Massachusetts	3	10, 713, 847	3, 737, 123	6, 896, 573	2, 322, 834	. 337	80, 151
Michigan	7	38, 573, 378	12, 444, 610	26, 101, 578	6, 812, 005	. 261	27, 190
Minnesota	3	10, 096, 614	4, 995, 818	(1)	(1)	(1)	(1)
New Jersey	2	14, 865, 262	2, 566, 969	12, 298, 293	(1)	(1)	----------
New York	9	58, 342, 988	17, 821, 829	39, 262, 770	13, 413, 922	. 342	1, 258, 389
Ohio	15	124, 852, 565	52, 141, 400	70, 575, 808	8, 270, 202	. 117	2, 135, 357
Pennsylvania	10	230, 927, 005	95, 191, 806	127, 030, 703	12, 972, 877	. 102	8, 704, 496
Tennessee	1	1, 524, 872	676, 258	848, 614	278, 529	. 328	----------
Utah	1	4, 932, 808	2, 269, 092	2, 149, 559	(1)	(1)	514, 157
Washington	1	669, 545	----------	629, 613	213, 587	. 339	39, 932
West Virginia	3	20, 432, 351	7, 913, 131	12, 179, 180	1, 386, 160	. 114	340, 040
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	5	21, 901, 748	7, 854, 246	(1)	(1)	(1)	(1)
Undistributed	------	----------	----------	18, 917, 282	11, 153, 991	. 216	231, 016
	85	775, 512, 939	302, 748, 528	454, 472, 572	76, 498, 857	. 168	18, 291, 839

[1] Included under "Undistributed."

TABLE 90.—*Use of by-product oven gas in the United States in 1928, by States*

State	Used under boilers			Used in steel or other affiliated plants		
	M cubic feet	Value		M cubic feet	Value	
		Total	Average		Total	Average
Alabama	8, 328, 195	$408, 899	$0. 049	24, 713, 376	$1, 891, 259	$0. 077
Colorado	----------	----------	------	5, 833, 275	(1)	(1)
Illinois	(1)	(1)	(1)	4, 266, 525	502, 807	. 118
Indiana	564, 984	47, 535	. 084	36, 640, 513	5, 074, 593	. 138
Maryland	----------	----------	------	5, 568, 800	(1)	(1)
Massachusetts	(1)	(1)	(1)	----------	----------	------
Michigan	(1)	(1)	(1)	(1)	(1)	(1)
Minnesota	(1)	(1)	(1)	(1)	(1)	(1)
New Jersey	----------	----------	------	----------	----------	------
New York	2, 127, 312	150, 412	. 071	16, 236, 836	1, 819, 265	. 112
Ohio	2, 187, 794	212, 735	. 097	56, 313, 918	6, 450, 615	. 115
Pennsylvania	(1)	(1)	(1)	115, 840, 778	10, 855, 754	. 094
Tennessee	85, 540	26, 714	. 312	----------	----------	------
Utah	197, 312	(1)	(1)	1, 775, 811	(1)	(1)
Washington	2, 917	2, 183	. 748	----------	----------	------
West Virginia	(1)	(1)	(1)	9, 519, 409	757, 507	. 080
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	(1)	(1)	(1)	----------	----------	------
Undistributed	5, 126, 058	284, 069	. 053	9, 423, 705	4, 157, 624	. 184
	18, 620, 112	1, 132, 547	. 061	286, 132, 946	31, 509, 424	. 110

[1] Included under "Undistributed."

TABLE 90.—*Use of by-product oven gas in the United States in 1928, by States*—Continued

State	Distributed through city mains			Sold for industrial purposes		
	M cubic feet	Value		M cubic feet	Value	
		Total	Average		Total	Average
Alabama	2,996,074	$462,046	$0.154	2,580,154	$266,911	$0.103
Colorado	--------	--------	--------	--------	--------	--------
Illinois	27,624,995	6,387,953	.231	(1)	(1)	(1)
Indiana	5,984,314	3,642,771	.609	5,473,090	943,683	.172
Maryland	6,780,299	(1)	(1)	--------	--------	--------
Massachusetts	6,768,110	2,263,802	.334	(1)	(1)	(1)
Michigan	16,158,836	4,212,208	.261	(1)	(1)	(1)
Minnesota	3,982,777	1,476,165	.371	--------	--------	--------
New Jersey	12,298,293	(1)	(1)	--------	--------	--------
New York	18,120,204	10,424,356	.575	2,778,418	1,019,889	.367
Ohio	3,500,886	729,464	.208	8,573,210	877,388	.102
Pennsylvania	7,862,787	1,893,359	.241	(1)	(1)	(1)
Tennessee	--------	--------	--------	763,074	251,815	.330
Utah	(1)	(1)	(1)	110,097	(1)	(1)
Washington	626,696	211,404	.337	--------	--------	--------
West Virginia	(1)	(1)	(1)	--------	--------	--------
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	10,108,275	3,065,743	.303	(1)	(1)	(1)
Undistributed	2,318,919	5,166,370	.241	4,310,006	561,559	.127
	125,131,465	39,935,641	.319	24,588,049	3,921,245	.159

[1] Included under "Undistributed."

TABLE 91.—*Yield and disposal of gas and number of plants supplying gas for certain uses, by States, in 1928*

State	Yield of gas (M cubic feet) per ton of coal coked	Disposal (per cent of total)						Number of plants	
		In coke plants		To steel or other affiliated plants	For distribution through city mains	For industrial purposes	Wasted	Supplying gas for city distribution	Supplying gas to steel or other affiliated plants
		For use in heating coke ovens	For use under boilers						
Alabama	11.3	40.3	11.8	35.1	4.2	3.7	4.9	3	4
Colorado	11.8	40.0	--------	55.5	--------	--------	4.5	--------	1
Illinois	10.5	35.1	(1)	8.6	55.7	(1)	.1	8	2
Indiana	10.8	44.0	.6	41.3	6.8	6.2	1.1	5	4
Maryland	11.3	33.1	--------	30.2	36.7	--------	--------	1	1
Massachusetts	10.3	34.9	(1)	--------	63.2	(1)	.7	3	--------
Michigan	11.4	32.2	(1)	(1)	41.9	(1)	.1	7	1
Minnesota	11.2	49.5	(1)	(1)	39.5	--------	(1)	2	1
New Jersey	11.9	17.3	--------	--------	82.7	--------	--------	2	--------
New York	10.6	30.5	3.6	27.8	31.1	4.8	2.2	7	3
Ohio	10.9	41.8	1.7	45.1	2.8	6.9	1.7	4	11
Pennsylvania	11.4	41.2	(1)	50.2	3.4	(1)	3.8	5	8
Tennessee	10.1	44.4	5.6	--------	--------	50.0	--------	--------	--------
Utah	11.0	46.0	4.0	36.0	(1)	2.2	10.4	1	1
Washington	10.4	--------	.4	--------	93.6	--------	6.0	1	--------
West Virginia	10.4	38.7	(1)	46.6	(1)	--------	1.7	1	2
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	11.0	35.9	(1)	--------	46.1	(1)	(1)	4	--------
	11.1	39.0	2.4	36.9	16.1	3.2	2.4	54	39

[1] Not at liberty to publish.

TABLE 92.—*Disposition of gas from by-product ovens in the United States, 1923–1928*

	Millions of cubic feet	Percentage of total production	Value	
			Total	Cents per M
1923				
Used under boilers	33, 741	5. 6	$1, 820, 808	5. 4
Used in steel or other related plants	200, 099	33. 3	22, 646, 134	11. 3
Distributed through city mains	65, 143	10. 8	23, 116, 578	35. 5
Sold for industrial purposes	19, 459	3. 3	4, 025, 700	20. 7
Total sold or used (not for ovens)	318, 442	53. 0	51, 609, 220	16. 2
Used in heating ovens	270, 168	44. 9		
Wasted	12, 545	2. 1		
Total produced	601, 155	100. 0		
1924				
Used under boilers	29, 794	5. 5	1, 729, 013	5. 8
Used in steel or other related plants	187, 172	34. 6	21, 007, 607	11. 2
Distributed through city mains	65, 677	12. 1	23, 486, 416	35. 8
Sold for industrial purposes	18, 561	3. 4	3, 561, 911	19. 2
Total sold or used (not for ovens)	301, 204	55. 6	49, 784, 947	16. 5
Used in heating ovens	229, 298	42. 4		
Wasted	10, 599	2. 0		
Total produced	541, 101	100. 0		
1925				
Used under boilers	25, 239	3. 9	1, 451, 253	5. 8
Used in steel or other related plants	230, 030	36. 0	26, 380, 657	11. 5
Distributed through city mains	77, 457	12. 1	29, 319, 309	37. 9
Sold for industrial purposes	29, 528	4. 6	4, 333, 000	14. 7
Total sold or used (not for ovens)	362, 254	56. 6	61, 484, 219	17. 0
Used in heating ovens	266, 112	41. 6		
Wasted	11, 278	1. 8		
Total produced	639, 644	100. 0		
1926				
Used under boilers	25, 954	3. 7	1, 438, 699	5. 5
Used in steel or other related plants	249, 841	35. 3	27, 955, 574	11. 2
Distributed through city mains	89, 566	12. 7	29, 978, 997	33. 5
Sold for industrial purposes	32, 553	4. 6	5, 313, 530	16. 3
Total sold or used (not for ovens)	397, 914	56. 3	64, 686, 800	16. 3
Used in heating ovens	296, 431	42. 0		
Wasted	12, 337	1. 7		
Total produced	706, 682	100. 0		
1927				
Used under boilers	25, 849	3. 7	1, 866, 342	7. 2
Used in steel or other related plants	244, 969	34. 9	26, 580, 340	10. 9
Distributed through city mains	106, 910	15. 2	36, 249, 081	33. 9
Sold for industrial purposes	30, 661	4. 4	5, 396, 405	17. 6
Total sold or used (not for ovens)	408, 389	58. 2	70, 092, 168	17. 2
Used in heating ovens	280, 771	40. 1		
Wasted	11, 735	1. 7		
Total produced	700, 895	100. 0		
1928				
Used under boilers	18, 620	2. 4	1, 132, 547	6. 1
Used in steel or other related plants	286, 133	36. 9	31, 509, 424	11. 0
Distributed through city mains	125, 132	16. 1	39, 935, 641	31. 9
Sold for industrial purposes	24, 588	3. 2	3, 921, 245	15. 9
Total sold or used (not for ovens)	454, 473	58. 6	76, 498, 857	16. 8
Used in heating ovens	302, 748	39. 0		
Wasted	18, 292	2. 4		
Total produced	775, 513	100. 0		

TABLE 93.—*Recapitulation of all gases used in heating by-product coke ovens, 1928, in M cubic feet*

[Some plants using producer gas were unable to specify the exact amount. For these estimates have been supplied, assuming 130 B. t. u. per cubic foot of producer gas]

	Coke-oven gas	Producer gas	Blue water gas	Blast-furnace gas	Total
Number of plants using gas specified:					
Furnace plants	46	1	1	1	[1]46
Other plants	33	17	4	1	[1]39
Total	79	18	5	2	[1]85
M cubic feet of gas used in heating ovens:					
Furnace plants	257, 542, 376	62, 652, 204	2, 391, 378	3, 948, 393	259, 615, 340
Other plants	45, 206, 152				112, 125, 163
Total	302, 748, 528	62, 652, 204	2, 391, 378	3, 948, 393	371, 740, 503

[1] As some plants use a combination of one or more other gases with coke-oven gas, the net totals are less than the sum of the entries in the preceding columns.

TABLE 94.—*Disposition of gas from by-product coke ovens, 1915–1928, in per cent*

Year	Wasted	Burned in coking process	Surplus sold or used (not for ovens)	Year	Wasted	Burned in coking process	Surplus sold or used (not for ovens)
1915	3. 2	57. 3	39. 5	1922	1. 9	45. 9	52. 2
1916	4. 0	58. 4	37. 6	1923	2. 1	44. 9	53. 0
1917	5. 4	55. 7	38. 9	1924	2. 0	42. 4	55. 6
1918	4. 1	54. 8	41. 1	1925	1. 8	41. 6	56. 6
1919	2. 6	51. 0	46. 4	1926	1. 8	42. 0	56. 3
1920	2. 2	49. 5	48. 3	1927	1. 7	40. 1	58. 2
1921	2. 9	47. 4	49. 7	1928	2. 4	39. 0	58. 6

TABLE 95.—*Trend in prices of gas per M cubic feet, 1913–1928*

Year	Average price to householders [1]		Average value of all gas sold [2]		
	Manufactured gas (44 cities)	Natural gas (8 cities)	Natural gas [3]	Coal, oil, and water gas	Coke-oven surplus gas [4]
1913	$0. 95	$0. 34	$0. 151	[5] $0. 91	$0. 088
1914	. 94	. 34	. 159	([6])	. 098
1915	. 93	. 34	. 161	. 91	. 102
1916	. 92	. 34	. 160	([6])	. 098
1917	. 91	. 35	. 179	. 87	. 087
1918	. 95	. 39	. 213	. 91	. 087
1919	1. 04	. 44	. 216	([6])	. 086
1920	1. 09	. 44	. 246	1. 06	. 140
1921	1. 32	. 49	. 264	[7] 1. 21	. 168
1922	1. 29	. 54	. 291	1. 16	. 167
1923	1. 25	. 55	. 238	[7] 1. 11	. 162
1924	1. 24	. 59	. 222	([6])	. 165
1925	1. 23	. 65	. 223	[7] 1. 10	. 170
1926	1. 23	. 66	. 229	([6])	. 163
1927	1. 22	. 66	. 220	[7] 1. 08	. 172
1928	1. 21	. 66	. 232	([6])	. 168

[1] Average of prices in effect on or near Apr. 15; from statistics of prices published by the Bureau of Labor Statistics. The figures for manufactured gas are the average net price per 1,000 cubic feet when 3,000 cubic feet is purchased, which amount the Bureau of Labor Statistics estimates to be the consumption of a typical family. Similarly the figures for natural gas are the average net price per 1,000 cubic feet when 5,000 cubic feet is purchased.

[2] As reported by operators to the Bureau of Mines.

[3] Average value of all natural gas at point of consumption or at town border when sold to local distributing company.

[4] Includes value of gas used by producer (not for ovens).

[5] Represents 1912.

[6] No report.

[7] Average value of all gas sold by city gas plants as reported by the Census of Manufactures, including coke-oven gas used for city distribution.

TABLE 96.—*Total sales of gas fuel in the United States, 1913–1928*

[Does not include producer gas, blast-furnace gas, Pintsch gas, or acetylene]

Year	Quantity sold (billion cubic feet)				Rough equivalent in heating value (billion B. t. u.)			
	1 Surplus coke-oven gas	2 Coal, oil, and water gas	3 Natural gas, all uses	4 Total	5 Surplus coke-oven gas (1×550)	6 Coal, oil, and water gas (2×575)	7 Natural gas (3×1, 075)	8 Total (5+6+7)
QUANTITY								
1913	64	[1] 166	582	812	35, 200	95, 450	626, 000	756, 650
1914	61	174	592	827	33, 550	100, 050	636, 000	769, 600
1915	84	[1] 182	629	895	46, 200	104, 650	676, 000	826, 850
1916	110	196	753	1, 059	60, 500	112, 700	810, 000	983, 200
1917	131	[1] 211	795	1, 137	72, 050	121, 325	855, 000	1, 048, 375
1918	158	234	721	1, 113	86, 900	134, 550	775, 000	996, 450
1919	193	[1] 248	746	1, 187	106, 150	142, 600	802, 000	1, 050, 750
1920	230	262	798	1, 290	126, 500	150, 650	858, 000	1, 135, 150
1921	154	[2] 269	662	1, 085	84, 700	154, 675	712, 000	951, 375
1922	231	257	763	1, 251	127, 050	147, 775	820, 000	1, 094, 825
1923	318	[2] 258	1, 007	1, 583	174, 900	148, 350	1, 082, 000	1, 405, 250
1924	301	[3] 260	1, 142	1, 703	165, 550	149, 500	1, 227, 000	1, 542, 050
1925	362	[2] 283	1, 189	1, 834	199, 100	162, 725	1, 278, 175	1, 640, 000
1926	398	[3] 290	1, 313	2, 001	218, 900	166, 750	1, 411, 475	1, 797, 125
1927	408	[4] 300	1, 445	[4] 2, 153	224, 400	[4] 172, 500	1, 553, 375	[4] 1, 950, 275
1928	454	[5] 300	1, 568	2, 322	249, 700	172, 500	1, 685, 600	2, 107, 800
PER CENT								
1913	7. 9	20. 5	71. 6	100. 0	4. 7	12. 6	82. 7	100. 0
1914	7. 4	21. 0	71. 6	100. 0	4. 4	13. 0	82. 6	100. 0
1915	9. 4	20. 3	70. 3	100. 0	5. 6	12. 6	81. 8	100. 0
1916	10. 4	18. 5	71. 1	100. 0	6. 2	11. 5	82. 3	100. 0
1917	11. 5	18. 6	69. 9	100. 0	6. 9	11. 6	81. 5	100. 0
1918	14. 2	21. 0	64. 8	100. 0	8. 7	13. 5	77. 8	100. 0
1919	16. 3	20. 9	62. 8	100. 0	10. 1	13. 6	76. 3	100. 0
1920	17. 8	20. 3	61. 9	100. 0	11. 1	13. 3	75. 6	100. 0
1921	14. 2	24. 8	61. 0	100. 0	8. 9	16. 3	74. 8	100. 0
1922	18. 5	20. 5	61. 0	100. 0	11. 6	13. 5	74. 9	100. 0
1923	20. 1	16. 3	63. 6	100. 0	12. 4	10. 6	77. 0	100. 0
1924	17. 7	15. 3	67. 0	100. 0	10. 7	9. 7	79. 6	100. 0
1925	19. 7	15. 4	64. 9	100. 0	12. 1	9. 9	78. 0	100. 0
1926	19. 9	14. 5	65. 6	100. 0	12. 2	9. 3	78. 5	100. 0
1927	[4] 19. 0	[4] 13. 9	[4] 67. 1	100. 0	11. 5	[4] 8. 8	[4] 79. 7	100. 0
1928	19. 5	12. 9	67. 6	100. 0	11. 9	8. 2	79. 9	100. 0

[1] Estimated by assuming a uniform rate of increase between successive years reported.

[2] Total sales of manufactured gas by city gas companies as reported by the Bureau of the Census minus gas purchased for mixing and resale minus sales of gas made in by-product ovens operated by city gas companies as determined by a special retabulation made by the Bureau of Mines in 1927.

[3] Estimated.

[4] Revised since last report. The figure given is the total production of coal, oil, and water gas as reported by the Bureau of the Census minus 7.5 per cent to allow for gas unaccounted for and used by producing company.

[5] Estimated; subject to revision.

NAPHTHALENE

TABLE 97.—*Naphthalene sold by by-product coke operators, 1918–1928*

Year	Quantity (pounds)			Value	Average receipts per pound (cents)		Receipts per ton of coke (cents)
	Crude	Refined	Total		Crude	Refined	
1918	10, 403, 758	5, 486, 689	15, 890, 447	$650, 229	2. 8	6. 6	2. 5
1919	4, 038, 455	2, 663, 585	6, 702, 040	191, 364	2. 0	4. 1	. 8
1920	11, 507, 703	2, 941, 059	14, 448, 762	487, 974	2. 7	6. 1	1. 6
1921	1, 652, 466	331, 057	1, 983, 523	59, 335	2. 5	5. 6	. 3
1922	3, 298, 851	1, 589, 084	4, 887, 935	131, 252	1. 6	5. 0	. 5
1923	10, 047, 427	1, 198, 206	11, 245, 633	239, 699	1. 7	5. 5	. 6
1924	7, 891, 116	327, 957	8, 219, 073	128, 208	1. 5	3. 6	. 4
1925	9, 692, 185	208, 332	9, 900, 517	97, 493	1. 0	2. 5	. 2
1926	7, 556, 372	166, 851	7, 723, 223	97, 310	1. 3	(1)	. 2
1927	7, 848, 224	----------	7, 848, 224	86, 078	1. 1	----------	. 2
1928	[2] 10, 937, 429		10, 937, 429	135, 693	[2] 1. 2		. 3

[1] Quantity sold too small to be representative.

[2] Crude and refined not separated.

TABLE 98.—*Total commercial production of naphthalene from all sources in the United States and imports, 1918–1928*

[Total sales are shown for coke plants and gas works to avoid double counting in production of crude and refined]

	By-product coke ovens; sales of crude and refined	City gas works; sales of crude and refined	Tar distilleries and all other establishments	Total commercial production
Quantity (pounds):				
1918	15, 890, 447	896, 080	40, 138, 092	56, 924, 619
1919	6, 702, 040	(1)	12, 612, 203	20, 114, 243
1920	14, 448, 762	1, 760, 293	26, 393, 411	42, 602, 466
1921	1, 983, 523	(1)	16, 949, 464	19, 432, 987
1922	4, 887, 935	(1)	19, 323, 393	25, 411, 328
1923	11, 245, 633	1, 115, 563	41, 453, 002	53, 814, 198
1924	8, 219, 073	(1)	34, 683, 803	44, 102, 876
1925	9, 900, 517	1, 266, 037	34, 135, 175	45, 301, 729
1926	7, 723, 223	(1)	45, 165, 957	53, 059, 180
1927	7, 848, 224	(1)	45, 298, 441	[2]53, 176, 665
1928	10, 937, 429	(1)	35, 179, 996	46, 157, 425
Value:				
1918	$650, 229	$14, 282	$1, 281, 440	$1, 945, 951
1919	191, 364	(1)	327, 201	542, 565
1920	487, 974	63, 449	791, 403	1, 342, 826
1921	59, 335	(1)	380, 167	462, 502
1922	131, 252	(1)	352, 957	536, 209
1923	239, 699	42, 247	652, 148	934, 094
1924	128, 208	(1)	441, 333	602, 541
1925	97, 493	34, 751	519, 773	652, 017
1926	97, 310	(1)	494, 986	594, 296
1927	86, 078	(1)	470, 806	[2]557, 884
1928	135, 693	(1)	395, 059	531, 752

	Imports of crude (free)[3]	Imports of refined (dutiable)[3]	Total imports[3]	Total produced and imported	Average spot price of flake in New York (cents per pound)
Quantity (pounds):					
1918	3, 902, 731	2, 795	3, 905, 526	60, 830, 145	------------
1919	3, 239, 256	7, 650	3, 246, 906	23, 361, 149	------------
1920	15, 012, 096	3, 697, 562	18, 709, 658	61, 312, 124	------------
1921	4, 495, 806	441, 685	4, 937, 491	24, 370, 478	------------
1922	3, 144, 332	75, 680	3, 220, 012	28, 631, 340	------------
1923	20, 992, 439	9, 605	21, 002, 044	74, 816, 242	------------
1924	5, 266, 708	4, 549	5, 271, 257	49, 374, 133	------------
1925	1, 979, 612	------------	1, 979, 612	47, 281, 341	------------
1926	6, 962, 719	424	6, 963, 143	60, 022, 323	------------
1927	6, 576, 500	18, 668	6, 595, 168	[2]59, 771, 833	------------
1928	19, 926, 289	27	19, 926, 316	66, 083, 741	------------
Value:					
1918	$130, 098	$171	$130, 269	$2, 076, 220	9. 9
1919	92, 265	384	92, 649	635, 214	7. 6
1920	530, 219	416, 172	946, 391	2, 289, 217	12. 7
1921	135, 943	31, 458	167, 401	629, 903	7. 2
1922	54, 029	7, 684	61, 713	597, 922	6. 1
1923	575, 563	194	575, 757	1, 509, 851	7. 5
1924	96, 491	1, 147	97, 638	700, 179	5. 5
1925	26, 593	------------	26, 593	678, 610	5. 4
1926	126, 088	125	126, 213	720, 509	5. 5
1927	131, 436	3, 077	134, 513	[2]692, 397	4. 6
1928	357, 679	6	357, 685	889, 437	4. 8

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[1] Data lacking or incomplete. Estimate included in total.
[2] Revised.
[3] Imports entered for consumption as reported by Tariff Commission.

BY-PRODUCT COKE OVENS OWNED BY CITY GAS COMPANIES, INCLUDED BY BUREAU OF THE CENSUS IN MANUFACTURED-GAS INDUSTRY

Reference has already been made (pp. 714, 715) to the group of by-product coke plants installed by city gas companies, which the Bureau of the Census classifies as a part of the "Manufactured-gas industry" and which the Bureau of Mines includes with the by-product coke industry.

The difference in classification is maintained by the two offices advisedly, in the interest of those who can use the statistics. For some purposes the census grouping is the more useful, and for others—particularly the design of ovens, technique of manufacture, and the supply and demand for coal and coke—the grouping used by the Bureau of Mines is the more significant.

To compare or combine the two sets of figures, however, allowance must be made for the difference in classification, which can be done by means of the data in Table 99, prepared for the purpose by the Bureau of Mines. The table shows in parallel columns separate figures for the group of by-product coke plants operated by city gas companies (grouped by the Bureau of the Census with the manufactured-gas industry) and for all other by-product coke plants. Thus, in 1928 there were 20 plants in the group owned by city gas companies, and they produced 2,744,431 tons of coke, 47,443,267,000 cubic feet of gas, 37,909,041 gallons of tar, 22,769,118 pounds of ammonia (NH_3 equivalent of all forms), and 2,376,700 gallons of crude light oil. Corresponding figures for each year from 1918 to 1925 are given in Coke and By-products in 1925, pages 610 to 615, and for 1926 in Coke and By-products in 1927, page 683. By subtracting the production from the census figures for the manufactured-gas industry anyone interested may obtain the quantities of the several products produced by gas works proper—that is, coal, oil, and water gas plants.

The table also shows the operations of the 65 plants not owned by city gas companies, which in 1928 produced 45,568,594 tons of coke, 728,069,672,000 cubic feet of gas, 593,935,726 gallons of tar, 376,674,142 pounds of NH_3, and 186,221,256 gallons of crude light oil. This group of plants is that covered by the census classification of "Coke, not including gas-house coke, made in by-product ovens." The figures are compiled by the Bureau of Mines from the reports of the coke producers and are accepted by the Bureau of the Census as its record of production in the years covered by the Census of Manufactures.

The totals for both groups of plants given in the last column of the table are the figures for the by-product coke industry as defined by the Bureau of Mines and given in the other tables of this report.

Both groups of by-product plants have been increasing in number and in volume of output. (See Table 100.) The number of public-utility plants rose from 9 in 1918 to 20 in 1928, and their sales of surplus gas increased in the same period from 7,450,191,000 to 39,827,389,000 cubic feet. At the same time, however, the sales of the plants not owned by city gas companies rose from 150,908,288,000 cubic feet in 1918 to 414,645,183,000 in 1928. The proportion of the total output of coke-oven gas contributed by the public-utility group was 8.8 per cent in 1928, as against 4.7 per cent in 1918.

TABLE 99.—*Production of coke, breeze, gas, and by-products at by-product coke plants owned by city gas companies (public utilities) and included by Bureau of the Census in manufactured-gas industry, and at all other by-product coke plants, 1927 and 1928*

Product	1927			1928		
	Plants not owned by city gas companies	Plants owned by city gas companies (public utilities)[1]	Total	Plants not owned by city gas companies	Plants owned by city gas companies (public utilities)[1]	Total
Total value	$340, 341, 529	$32, 648, 652	$372, 990, 181	$562, 833, 399	$63, 404, 235	$626, 237, 634
Number of active plants	62	17	79	65	20	85
Coke:						
Production, net tons	41, 924, 796	1, 959, 930	43, 884, 726	45, 568, 594	2, 744, 431	48, 313, 025
Value	$216, 910, 855	$15, 132, 948	$232, 043, 803	$216, 635, 392	$19, 879, 812	$236, 515, 204
Average value	$5. 17	$7. 72	$5. 29	$4. 75	$7. 24	$4. 90
Screenings and breeze:						
Production, net tons	3, 893, 411	206, 291	4, 099, 702	4, 119, 139	259, 100	4, 378, 239
Sales, do	713, 635	2, 602	716, 237	819, 741	10, 394	830, 135
Value	$2, 031, 674	$10, 822	$2, 042, 496	$2, 246, 080	$23, 865	$2, 269, 945
Average value	$2. 85	$4. 16	$2. 85	$2. 74	$2. 30	$2. 73
Coke:						
Used by producer—						
Quantity, net tons	30, 365, 658	321, 540	30, 687, 198	33, 371, 502	567, 413	33, 938, 915
Value	$143, 125, 332	$1, 997, 884	$145, 123, 216	$147, 128, 931	$3, 827, 697	$150, 956, 628
Sales—						
Quantity, net tons	11, 097, 506	1, 493, 038	12, 590, 544	12, 199, 859	2, 117, 524	14, 317, 383
Value	$70, 798, 170	$11, 871, 602	$82, 669, 772	$69, 461, 996	$15, 724, 333	$85, 186, 329
By-products:						
Gas—						
Production, M cubic feet	667, 161, 377	33, 733, 422	700, 894, 799	728, 069, 672	47, 443, 267	775, 512, 939
Sales of surplus—						
Used under boilers—						
Quantity, M cubic feet	25, 758, 103	90, 659	25, 848, 762	18, 519, 842	100, 270	18, 620, 112
Value	$1, 849, 196	$17, 146	$1, 866, 342	$1, 099, 014	$33, 533	$1, 132, 547
Used in steel or affiliated plants—						
Quantity, M cubic feet	244, 897, 054	72, 285	244, 969, 339	286, 122, 585	10, 361	286, 132, 946
Value	$26, 567, 782	$12, 558	$26, 580, 340	$31, 503, 649	$5, 775	$31, 509, 424
Distributed through city mains—						
Quantity, M cubic feet	82, 473, 444	24, 436, 664	106, 910, 108	87, 206, 546	37, 924, 919	125, 131, 465
Value	$22, 823, 046	$13, 426, 035	$36, 249, 081	$21, 129, 683	$18, 805, 958	$39, 935, 641
Sold for industrial use—						
Quantity, M cubic feet	28, 177, 884	2, 483, 264	30, 661, 148	22, 796, 210	1, 791, 839	24, 588, 049
Value	$4, 333, 835	$1, 062, 570	$5, 396, 405	$2, 922, 257	$998, 988	$3, 921, 245
Tar—						
Production, gallons	519, 378, 540	27, 480, 665	546, 859, 205	593, 935, 726	37, 909, 041	631, 844, 767
Sales—						
Quantity, do	278, 473, 948	27, 424, 228	305, 898, 176	295, 248, 205	36, 902, 065	332, 150, 270
Value	$14, 570, 126	$1, 525, 352	$16, 095, 478	$15, 478, 184	$2, 066, 613	$17, 544, 797
Average value	$0. 052	$0. 056	$0. 053	$0. 052	$0. 056	$0. 053
Ammonia—						
Production (NH_3 equivalent of all forms), pounds	[2] 342, 987, 071	[2] 15, 743, 017	358, 730, 088	376, 674, 142	22, 769, 118	399, 443, 260
Liquor (NH_3 equivalent)—						
Production, pounds	49, 825, 891	4, 868, 832	54, 694, 723	48, 758, 744	3, 710, 712	52, 469, 456
Sales, do	49, 011, 372	4, 982, 955	53, 994, 327	48, 811, 135	3, 773, 840	52, 584, 975
Value	$2, 335, 047	$245, 295	$2, 580, 342	$2, 385, 556	$127, 756	$2, 513, 312
Sulphate—						
Production, pounds	1, 172, 644, 719	43, 496, 741	1, 216, 141, 460	1, 311, 661, 590	76, 233, 624	1, 387, 895, 214
Sales, do	1, 225, 624, 762	42, 129, 207	1, 267, 753, 969	1, 242, 078, 323	76, 291, 481	1, 318, 369, 804
Value	$23, 904, 793	$898, 133	$24, 802, 926	$23, 245, 960	$1, 580, 784	$24, 826, 744
Crude light oil—						
Production, gallons	161, 956, 695	2, 531, 538	164, 488, 233	186, 221, 256	2, 376, 700	188, 597, 956
Sales, do	8, 264, 543	1, 001, 405	9, 265, 948	9, 544, 224	790, 589	10, 334, 813
Value	$954, 635	$123, 322	$1, 077, 957	$1, 062, 115	$96, 731	$1, 158, 846

[1] Includes all by-product ovens built by city gas companies, some of which are operated in conjunction with coal, oil, and water-gas plants. Does not include independent by-product plants which may sell gas to public-utility companies for distribution.

[2] Revised since last report.

Table 99.—*Production of coke, breeze, gas, and by-products at by-product coke plants owned by city gas companies (public utilities) and included by Bureau of the Census in manufactured-gas industry, and at all other by-product coke plants, 1927 and 1928*—Continued

Product	1927			1928		
	Plants not owned by city gas companies	Plants owned by city gas companies (public utilities)	Total	Plants not owned by city gas companies	Plants owned by city gas companies (public utilities)	Total
By-products—Continued.						
Light-oil derivatives—						
Production____gallons__	127, 992, 291	1, 239, 169	129, 231, 460	147, 909, 404	1, 394, 001	149, 303, 405
Sales______________do____	123, 821, 774	1, 015, 608	124, 837, 382	145. 180, 795	1, 249, 070	146, 429, 865
Value_________________	$23, 881, 757	$193, 385	$24, 075, 142	$27, 491, 315	$229, 646	$27, 720, 961
Naphthalene, crude and refined—						
Production__pounds____	8, 228, 400	74, 445	8, 302, 845	12, 115, 089	67, 054	12, 182, 143
Sales__________do________	7, 773, 779	74, 445	7, 848, 224	10, 870, 375	67, 054	10, 937, 429
Value_________________	$84, 992	$1, 086	$86, 078	$134, 790	$903	$135, 693
All other products, value__	$93, 791	___________	$93, 791	$908, 477	$1, 841	$910, 318

Table 100.—*Summary of operations of by-product plants owned by city gas companies and of all other by-product coke plants, 1918–1928*

[The plants owned by city gas companies are included by the Bureau of the Census in the manufactured-gas industry]

Year	Plants not owned by city gas companies					Plants owned by city gas companies (public utilities)				
	Number of plants	Coke produced		Surplus gas[1]		Number of plants	Coke produced		Surplus gas[1]	
		Net tons	Per cent of total by-product coke	M cubic feet	Per cent of total surplus gas		Net tons	Per cent of total by-product coke	M cubic feet	Per cent of total surplus gas
1918_______	51	24, 919, 395	95. 9	150, 908, 288	95. 3	9	1, 078, 185	4. 1	7, 450, 191	4. 7
1919_______	56	23, 894, 658	95. 1	183, 468, 750	95. 1	9	1, 242, 963	4. 9	9, 355, 344	4. 9
1920_______	59	29, 637, 341	96. 1	221, 032, 497	95. 9	9	1, 196, 610	3. 9	9, 383, 422	4. 1
1921_______	60	19, 045, 898	96. 4	148, 166, 088	96. 0	7	703, 682	3. 6	6, 134, 910	4. 0
1922_______	57	27, 889, 475	97. 7	226, 152, 451	97. 7	7	661, 070	2. 3	5, 230, 567	2. 3
1923_______	58	36, 637, 455	97. 4	310, 789, 918	97. 6	7	960, 209	2. 6	7, 652, 336	2. 4
1924_______	60	33, 072, 640	97. 3	292, 368, 617	97. 1	11	910, 928	2. 7	8, 835, 236	2. 9
1925_______	61	38, 786, 990	97. 2	350, 178, 112	96. 7	13	1, 125, 169	2. 8	12, 076, 160	3. 3
1926_______	62	42, 894, 780	96. 7	381, 477, 264	95. 9	15	1, 481, 806	3. 3	16, 436, 824	4. 1
1927_______	62	41, 924, 796	95. 5	381, 306, 485	93. 4	17	1, 959, 930	4. 5	27, 082, 872	6. 6
1928_______	65	45, 568, 594	94. 3	414, 645, 183	91. 2	20	2, 744, 431	5. 7	39, 827, 389	8. 8

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[1] Surplus gas sold or used for purposes other than heating coke ovens, exclusive of a small amount wasted.

PRODUCTION OF COKE, 1880–1928, BY STATES

TABLE 101.—*Coke produced in the United States, 1880–1928, by States, in net tons*

[1928 production of Connecticut included under "Combined States"; no figures for other years]

Year	Alabama	Colorado	Georgia	Illinois	Indiana	Kansas	Kentucky	Maryland	Massachusetts	Michigan	Minnesota	Missouri	Montana	New Jersey	New Mexico
1880	60,781	25,568	38,041	12,700	----------	3,070	4,250	----------	----------	----------	----------	----------	----------	----------	----------
1881	109,033	48,587	41,376	14,800	----------	5,670	4,370	----------	----------	----------	----------	----------	----------	----------	----------
1882	152,940	102,105	46,602	11,400	----------	6,080	4,070	----------	----------	----------	----------	----------	----------	----------	1,000
1883	217,531	133,997	67,012	13,400	----------	8,430	5,025	----------	----------	----------	----------	----------	----------	----------	3,905
1884	244,009	115,719	79,268	13,095	----------	7,190	2,223	----------	----------	----------	----------	----------	75	----------	18,282
1885	301,180	131,960	70,669	10,350	----------	8,050	2,704	----------	----------	----------	----------	----------	175	----------	17,940
1886	375,054	142,797	82,680	8,103	6,124	12,493	4,528	----------	----------	----------	----------	----------	----------	----------	10,236
1887	325,020	170,698	79,241	9,198	17,658	14,950	14,565	----------	----------	----------	----------	2,970	7,200	----------	13,710
1888	508,511	179,682	83,721	7,410	11,956	14,831	23,150	----------	----------	----------	----------	2,600	12,000	----------	8,540
1889	1,030,510	187,638	94,727	11,583	8,301	13,910	13,021	----------	----------	----------	----------	5,275	14,043	----------	3,460
1890	1,072,942	245,756	102,233	5,000	6,013	12,311	12,343	----------	----------	----------	----------	6,136	14,427	----------	2,050
1891	1,282,496	277,074	103,057	5,200	3,798	14,174	33,777	----------	----------	----------	----------	6,872	29,009	----------	2,300
1892	1,501,571	[1]373,229	81,807	3,170	3,207	9,132	36,123	----------	----------	----------	----------	7,299	34,557	----------	----------
1893	1,168,085	[1]362,986	90,726	2,200	5,724	8,565	48,619	----------	----------	----------	----------	5,905	29,945	----------	5,803
1894	923,817	[1]317,196	93.029	2,200	6,551	8,439	29,748	----------	----------	----------	----------	2,250	17,388	----------	6,529
1895	1,444,339	[1]340,357	60,212	2,250	4,804	5,287	25,460	----------	----------	----------	----------	2,028	25,337	----------	14,663
1896	1,479,437	[1]363,760	53,673	2,600	4,353	4,785	27,107	----------	----------	----------	----------	2,500	60,078	----------	24,228
1897	1,443,017	[1]342,653	33,000	1,549	2,904	6,181	32,117	----------	----------	----------	----------	2,593	67,849	----------	1,438
1898	1,663,020	[1]474,808	49,529	2,325	1,825	4,180	22,242	----------	----------	----------	----------	740	52,009	----------	6,980
1899	1,787,809	[1]530,424	50,907	[2]2,370	(2)	14,476	81,095	----------	(3)	----------	----------	2,860	56,376	----------	44,134
1900	2,110,837	[1]618,755	73,928	(4)	(4)	5,948	95,532	----------	(4)	(4)	----------	2,087	54,731	----------	44,774
1901	2,148,911	[1]671,303	54,550	(4)	(4)	7,138	100,285	----------	(4)	(4)	----------	4,749	57,004	----------	41,643
1902	2,552,246	[1]1,003,393	82,064	(4)	(4)	20,902	126,879	----------	(4)	(4)	----------	5,780	53,463	----------	23,296
1903	2,693,497	[1]1,053,840	85,546	(4)	(4)	14,194	115,362	(4)	(4)	(4)	----------	1,839	45,107	(4)	11,050
1904	2,340,219	[1]789,060	75,812	4,439	(4)	9,460	64,112	(4)	(4)	(4)	(4)	2,446	41,497	(4)	58,259
1905	2,576,986	[1]1,378,824	70,593	10,307	----------	4,425	79,487	(4)	(4)	(4)	(4)	1,580	31,482	(4)	89,638
1906	3,034,501	[1]1,455,905	70,280	268,693	----------	1,698	74,064	(4)	(4)	(4)	(4)	----------	38,182	(4)	147,747
1907	3,021,794	[1]1,421,579	74,934	372,697	----------	6,274	67,068	332,253	466,458	(4)	(4)	----------	40,714	256,057	265,125
1908	2,362,666	[1]982,291	39,422	362,182	(4)	2,497	37,827	270,916	453,883	(4)	(4)	----------	(4)	248,893	274,565
1909	3,085,824	[1]1,251,805	46,385	1,276,956	(4)	----------	46,371	315,587	444,349	(4)	(4)	----------	(4)	261,460	373,967
1910	3,249,027	[1]1,346,211	43,814	1,514,504	(4)	(4)	53,857	335,373	450,001	(4)	(4)	----------	(4)	250,153	401,646
1911	2,761,521	[1]1,177,023	37,553	1,610,212	(4)	(4)	66,099	343,451	477,564	(4)	(4)	----------	(4)	255,334	381,927
1912	2,975,489	972,941	43,158	1,764,944	2,616,339	(4)	191,555	304,715	511,596	(4)	(4)	----------	----------	304,715	413,906
1913	3,323,664	879,461	42,747	1,859,553	2,727,025	----------	317,084	236,423	531,384	(4)	(4)	----------	----------	255,792	467,945
1914	3,084,149	666,083	24,517	1,425,168	2,276,652	----------	443,959	87,852	540,631	(4)	(4)	----------	----------	255,283	362,572
1915	3,071,811	670,938	20,039	1,686,998	2,768,099	----------	526,097	313,283	504,438	(4)	127,847	(4)	----------	269,448	389,411
1916	4,298,417	1,053,553	47,127	2,320,400	3,489,660	----------	802,526	489,982	563,048	(4)	431,319	(4)	----------	210,766	502,812

[1] Utah included with Colorado.

[2] Indiana included with Illinois.

[3] Included with Pennsylvania.

[4] Included under "Combined States."

TABLE 101.—*Coke produced in the United States, 1880–1928, by States, in net tons*—Continued

Year	Alabama	Colorado	Georgia	Illinois	Indiana	Kansas	Kentucky	Maryland	Massachusetts	Michigan	Minnesota	Missouri	Montana	New Jersey	New Mexico
1917	4, 892, 589	1, 112, 449	39, 589	2, 289, 833	3, 540, 718	----------	863, 071	518, 810	595, 113	(4)	490, 272	(4)	----------	423, 361	577, 679
1918	4, 352, 172	989, 447	22, 048	2, 285, 610	3, 898, 215	----------	818, 785	474, 368	556, 397	(4)	784, 065	(4)	----------	682, 148	597, 072
1919	3, 380, 771	613, 753	18, 149	1, 703, 903	3, 702, 180	----------	691, 969	356, 237	393, 331	808, 729	586, 094	(4)	----------	788, 465	260, 162
1920	4, 013, 891	789, 499	16, 523	2, 136, 793	4, 553, 697	----------	739, 577	682, 132	488, 089	1, 393, 445	674, 801	(4)	----------	725, 571	(4)
1921	2, 534, 039	368, 131	6, 943	1, 322, 178	3, 091, 263	----------	284, 825	292, 439	294, 059	777, 125	435, 866	(4)	----------	739, 768	(4)
1922	3, 799, 865	484, 039	8, 832	1, 982, 906	3, 995, 505	----------	487, 167	589, 893	407, 081	1, 142, 059	462, 044	(4)	----------	790, 811	87, 631
1923	4, 654, 075	647, 823	12, 556	3, 187, 168	5, 042, 614	----------	559, 711	861, 668	554, 125	1, 648, 773	695, 824	(4)	----------	897, 569	(4)
1924	4, 541, 058	735, 520	8, 081	2, 355, 474	4, 272, 435	----------	(4)	810, 118	397, 640	1, 770, 547	514, 764	(4)	----------	869, 120	83, 070
1925	4, 670, 481	644, 481	4, 925	3, 011, 497	5, 141, 940	----------	(4)	1, 019, 209	535, 302	1, 751, 118	518, 355	(4)	----------	903, 997	(4)
1926	(4)	790, 118	3, 059	3, 336, 962	5, 990, 344	----------	(4)	1, 120, 610	573, 748	1, 826, 638	619, 905	(4)	----------	913, 250	(4)
1927	4, 364, 354	788, 586	(4)	3, 013, 940	5, 549, 762	----------	(4)	1, 077, 309	744, 091	1, 920, 394	632, 628	(4)	----------	906, 321	----------
1928	4, 327, 324	750, 022	(4)	3, 240, 964	6, 094, 201	----------	(4)	1, 186, 398	687, 356	2, 399, 656	622, 696	(4)	----------	903, 177	----------

Year	New York	Ohio	Oklahoma (Indian Territory)	Pennsylvania	Rhode Island	Tennessee	Texas	Utah	Virginia	Washington	West Virginia	Wisconsin	Wyoming	Combined States	Total
1880	----------	100, 596	1, 546	2, 821, 384	----------	130, 609	----------	1, 000	----------	----------	138, 755	----------	----------	----------	3, 338, 300
1881	----------	119, 469	1, 768	3, 437, 708	----------	143, 853	----------	----------	----------	----------	187, 126	----------	----------	----------	4, 113, 760
1882	----------	103, 722	2, 025	3, 945, 034	----------	187, 695	----------	250	----------	----------	230, 398	----------	----------	----------	4, 793, 321
1883	----------	87, 834	2, 573	4, 438, 464	----------	203, 691	----------	----------	25, 340	----------	257, 519	----------	----------	----------	5, 464, 721
1884	----------	62, 709	1, 912	3, 822, 128	----------	219, 723	----------	----------	63, 600	400	223, 472	----------	----------	----------	4, 873, 805
1885	----------	39, 416	3, 584	3, 991, 805	----------	218, 842	----------	----------	49, 139	311	260, 571	----------	----------	----------	5, 106, 696
1886	----------	34, 932	6, 351	5, 406, 597	----------	368, 139	----------	----------	122, 352	825	264, 158	----------	----------	----------	6, 845, 369
1887	----------	93, 004	10, 060	5, 832, 849	----------	396, 979	----------	----------	166, 947	14, 625	442, 031	----------	----------	----------	7, 611, 705
1888	----------	67, 194	7, 502	6, 545, 779	----------	385, 693	----------	----------	149, 199	----------	531, 762	500	----------	----------	8, 540, 030
1889	----------	75, 124	6, 639	7, 659, 055	----------	359, 710	----------	761	146, 528	3, 841	607, 880	16, 016	----------	----------	10, 258, 022
1890	----------	74, 633	6, 639	8, 560, 245	----------	348, 728	----------	8, 258	165, 847	5, 837	833, 377	24, 976	----------	----------	11, 508, 021
1891	----------	38, 718	9, 464	6, 954, 846	----------	364, 318	----------	7, 949	167, 516	6, 000	1, 009, 051	34, 387	2, 682	----------	10, 352, 688
1892	----------	51, 818	3, 569	8, 327, 612	----------	354, 096	----------	(1)	147, 912	7, 177	1, 034, 750	33, 800	----------	----------	12, 010, 829
1893	12, 850	22, 436	7, 135	6, 229, 051	----------	265, 777	----------	(1)	125, 092	6, 731	1, 062, 076	14, 958	2, 916	----------	9, 477, 580
1894	16, 500	32, 640	3, 051	6, 063, 777	----------	292, 646	----------	(1)	180, 091	5, 245	1, 193, 933	4, 250	4, 352	----------	9, 203, 632
1895	18, 521	29, 050	5, 175	9, 404, 215	----------	396, 790	286	(1)	244, 738	15, 129	1, 285, 206	4, 972	4, 895	----------	13, 333, 714
1896	(3)	80, 868	21, 021	[5] 7, 356, 502	----------	339, 202	----------	(1)	268, 081	25, 949	1, 649, 755	5, 332	19, 542	----------	11, 788, 773
1897	(3)	95, 087	30, 364	[5] 8, 966, 924	----------	368, 769	394	(1)	354, 067	26, 189	1, 472, 666	17, 216	24, 007	----------	13, 288, 984
1898	(3)	85, 535	34, 110	[5] 10, 715, 302	----------	394, 545	----------	(1)	531, 161	30, 197	1, 925, 071	35, 280	18, 350	----------	16, 047, 209
1899	(3)	83, 878	24, 339	[6] 13, 577, 870	----------	435, 308	----------	(1)	618, 707	30, 372	2, 278, 577	33, 437	15, 630	----------	19, 668, 569
1900	(4)	72, 116	38, 141	13, 357, 295	----------	475, 432	----------	(1)	685, 156	33, 387	2, 358, 499	(4)	(4)	506, 730	20, 533, 348
1901	(4)	108, 774	37, 374	14, 355, 917	----------	404, 017	----------	(1)	907, 130	49, 197	2, 283, 700	(4)	(4)	564, 191	21, 795, 883
1902	(4)	146, 099	49, 411	16, 497, 910	----------	560, 006	----------	(1)	1, 124, 572	40, 305	2, 516, 505	(4)	(4)	598, 869	25, 401, 730
1903	(4)	143, 913	49, 818	15, 650, 932	----------	546, 875	----------	(1)	1, 176, 439	45, 623	2, 707, 818	(4)	(4)	932, 428	25, 274, 281

1904	(4)	109,284	44,808	14,861,064	--------	379,240	--------	(1)	1,101,716	45,432	2,283,086	(4)	(4)	1,451,172	23,661,106
1905	(4)	277,130	54,781	20,573,736	--------	468,092	--------	(1)	1,499,481	53,137	3,400,593	(4)	(4)	1,660,857	32,231,129
1906	(4)	293,994	49,782	23,060,511	--------	483,428	--------	(1)	1,577,659	45,642	3,713,514	(4)	(4)	2,085,617	36,401,217
1907	385,478	270,634	19,089	26,513,214	--------	467,499	--------	(1)	1,545,280	52,028	4,112,896	(4)	----------	1,088,493	40,779,564
1908	473,569	159,578	2,944	15,511,634	--------	214,528	--------	(1)	1,162,051	38,889	2,637,123	(4)	----------	798,060	26,033,518
1909	523,551	222,711	(4)	24,905,525	--------	261,808	--------	(1)	1,347,478	42,981	3,943,948	(4)	----------	964,359	39,315,065
1910	652,459	282,315	(4)	26,315,607	--------	322,756	--------	(1)	1,493,655	59,337	3,803,850	(4)	----------	1,134,245	41,708,810
1911	686,172	311,382	------------	21,923,935	--------	330,418	--------	(1)	910,411	40,180	2,291,049	(4)	----------	1,947,258	35,551,489
1912	794,618	388,669	------------	27,438,693	--------	370,076	--------	(4)	967,947	49,260	2,465,986	(4)	----------	1,408,992	43,983,599
1913	758,486	351,846	------------	28,753,444	--------	364,578	--------	(4)	1,303,603	76,221	2,472,752	(4)	----------	1,577,522	46,299,530
1914	457,370	521,638	------------	20,258,393	--------	264,127	--------	(4)	780,984	84,923	1,427,962	(4)	----------	1,593,651	34,555,914
1915	684,461	684,658	------------	25,622,862	--------	256,973	--------	(4)	629,807	136,552	1,391,446	(4)	----------	1,825,982	41,581,150
1916	775,014	1,803,268	------------	31,279,695	--------	382,175	--------	(7)	1,242,332	[7] 534,653	2,521,309	(4)	----------	1,785,529	54,533,585
1917	993,184	3,694,302	------------	27,912,025	--------	411,326	--------	(7)	1,304,230	[7] 497,533	3,349,761	(4)	----------	2,100,983	55,606,828
1918	1,069,587	5,365,243	(4)	26,723,645	--------	427,106	--------	(4)	1,234,256	123,788	3,320,006	(4)	----------	2,754,414	56,478,372
1919	751,067	5,481,660	(4)	20,501,831	(4)	260,915	--------	(4)	930,516	62,546	1,413,932	(4)	----------	1,474,347	44,180,557
1920	1,040,192	5,701,810	------------	23,638,739	(4)	301,708	--------	(4)	1,027,788	59,395	1,828,336	(4)	----------	1,533,057	51,345,043
1921	746,916	3,028,423	------------	9,769,476	(4)	85,728	--------	(4)	280,476	27,260	397,892	(4)	----------	804,815	25,287,622
1922	1,494,992	5,011,138	------------	13,991,892	(4)	113,896	--------	172,453	378,656	31,674	919,744	(4)	----------	771,734	37,124,012
1923	1,783,948	6,473,606	(4)	25,624,286	(4)	304,511	--------	232,941	774,887	69,068	1,762,775	(4)	----------	1,189,606	56,977,534
1924	1,600,669	5,832,699	------------	16,927,437	(4)	207,475	--------	257,094	485,064	71,615	1,328,569	(4)	----------	1,201,156	44,269,605
1925	2,219,409	7,261,18[illegible]	------------	19,427,603	(4)	216,488	--------	314,159	421,691	79,257	1,546,032	(4)	----------	1,579,812	51,266,943
1926	2,827,805	7,632,806	------------	21,922,976	(4)	241,034	--------	306,231	370,983	67,286	1,713,461	(4)	----------	6,608,321	56,865,537
1927	3,602,642	[8] 7,213,619	------------	16,777,291	(4)	227,120	--------	282,048	316,754	71,271	1,923,427	(4)	----------	1,680,586	51,092,143
1928	3,802,657	[8] 7,786,199	------------	16,917,355	(4)	216,925	--------	274,600	247,734	59,502	1,798,900	(4)	----------	1,490,162	52,805,828

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[1] Utah included with Colorado.
[3] Included with Pennsylvania.
[4] Included under "Combined States."
[5] Includes New York.
[6] Includes Massachusetts and New York.
[7] Utah included with Washington.
[8] By-product coke only. Beehive coke can not be shown without disclosing individual operations; it is included under "Combined States."